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*Presented by Thomas Watson, M.D.
President of the College.
1864.*

THERAPEUTICS

AND

MATERIA MEDICA.

HOC SUM CONTENTUS QUOD, ETIAMSI QUOMODO QUIDQUE FIAT
IGNOREM, QUID FIAT INTELLIGO. . . . QUID SCAMMONEÆ RADIX AD
PURGANDUM, QUID ARISTOLOCHIA AD MORSUS SERPENTUM POSSIT,
VIDEO: QUOD SATIS EST; CUR POSSIT NESCIO.

CICERO, *De Divinatione.*

THERAPEUTICS
AND
MATERIA MEDICA.

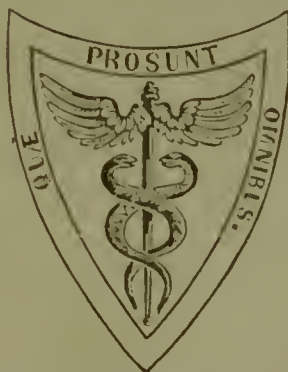
A SYSTEMATIC TREATISE
ON THE
ACTION AND USES OF MEDICINAL AGENTS,
INCLUDING THEIR
DESCRIPTION AND HISTORY.

BY

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VOL. I.



PHILADELPHIA:
BLANCHARD AND LEA.
1860.

Entered according to the Act of Congress, in the year 1860, by
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PHILADELPHIA:
COLLINS, PRINTER.

TO
THE ALUMNI
OF THE
MEDICAL DEPARTMENT OF PENNSYLVANIA COLLEGE,
IN ACKNOWLEDGMENT OF THEIR FLATTERING APPRECIATION OF HIS SERVICES
AS
PROFESSOR OF THE THEORY AND PRACTICE OF MEDICINE,
AND OF THE
UNIFORM KINDNESS OF THEIR PERSONAL INTERCOURSE WITH HIM,

• This Work

IS RESPECTFULLY AND CORDIALLY DEDICATED,

BY THEIR FRIEND,

ALFRED STILLÉ.

P R E F A C E .

SOME years have elapsed since the present work was undertaken and announced, but its completion has been delayed by several causes, chief of which were the author's election to the chair of Theory and Practice of Medicine in the Medical Department of Pennsylvania College, and the onerous duties which that office imposed upon him during a period of five years. The studies which they rendered necessary have tended greatly to enlarge the original plan of his treatise, and have also, it is hoped, rendered it more worthy than it would otherwise have been of a favorable reception by physicians and students of medicine. Intended for those who desire to learn the surest methods of curing disease, it has seemed not only allowable, but imperative, that in the form of the work scientific unity and precision should be subordinated to practical utility. At the same time, it would have been unpardonable to leave out of sight those fragments of scientific knowledge which may one day serve to bridge the chasm between theory and practice, and convert the precepts of therapeutics into laws.

The strictly scientific portion of the subject embraces the consideration of medicines in their physical, chemical, and physiological relations. Of these, the first and second are described so fully and accurately in works which rank among medical classics, that it seemed unnecessary to discuss them at length in a treatise whose point of view is rather at the bedside of the sick than in the laboratory or the lecture-room. On the other hand, the action of medicines upon the sound organism of man and of the lower animals forms an indispensable key to their curative operation in disease. The more thoroughly it is known, the more intelligible must the mode become in which medicines bring about the restoration of soundness of structure and function, and the more will the isolated facts of therapeutics tend to arrange themselves in a systematic form. If this division of the subject is more copiously illustrated than is usual in treatises on the *Materia Medica*, it may perhaps the better serve to aid the sagacious reader in explaining the operation of remedies, and to suggest new occasions for their employment.

Our knowledge of the usefulness of medicines rests altogether upon experience, but not upon that of any one man, however skillful, or of any age, however enlightened; their efficacy is attested by a multitude of witnesses, and is confirmed by time, which reduces the opinions of individuals to their just value, outlives the fashions of the day, and is unmoved by the prejudices of the schools. To experience, then, we must turn as the ultimate and decisive arbiter of all questions respecting the curative virtues of medicines, feeling assured that whenever the particular application of a remedy can be sustained by the testimony of the great physicians of successive ages, our employment of it possesses the highest possible sanction. In this conviction, the reader of the present work will, it is hoped, find a motive and a justification for the citations and references with which it abounds. It would have been a lighter task, by far, to rest the recommendation of particular remedies and methods of cure upon principles deduced, with more or less plausibility, from their supposed mode of action, and from the intimate pathological conditions for the removal of which they are presumed to be adapted. But as all such principles, when brought to the test of experience, have proved fallacious or insufficient, it was judged that a laborious comparison of actual results would compensate by its real utility for the exclusion of speculations which tend more to gratify an author's vanity, and flatter the reader's fancy, than to promote sound learning or render the treatment of disease more intelligible and successful. It is, indeed, impossible, in such a work, to present in detail the observations, or even the conclusions, of medical writers; and therefore, while it has been attempted to furnish a truthful, although a succinct, account of both, numerous references to original sources of information are provided for those who desire to prosecute the investigation. These consist of ancient classical authorities, and modern writers of the highest reputation in the Italian, French, German, and English languages, whose observations have been preserved in special essays, or in that great repository of facts, the periodical medical literature of the present century. It seemed as if a treatise executed in so catholic a spirit, and with no conscious bias towards any sect or school, ought to contain a large proportion of solid and useful truth; but as the author is far from presuming that he has fully accomplished his design, he craves the reader's indulgence for the shortcomings of his work, in favor of the spirit which inspired it.

PHILADELPHIA, *January*, 1860.

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THERAPEUTICS

AND

MATERIA MEDICA.

INTRODUCTION.

MEDICINES are substances used for the CURE OF DISEASES.

In the natural sciences which treat of living organized structure, an absolute definition of terms is impossible. This statement is eminently true of medicine—the most complex of all sciences, and the only one whose peculiar province it is to investigate the laws of processes which are themselves departures from law.

If those substances only which are exclusively appropriated to the treatment of disease were included among medicines, the number of these latter would be greatly diminished. But many are employed in the arts, as the metals and their compounds; many are used for food, as sugar, alcohol, albumen, gelatin, fat, oil, &c.; many as condiments, as salt, saltpetre, pepper, mustard, vinegar, garlic, &c. In all of these, and in a thousand similar cases, the medicinal use of a substance is secondary and subordinate to that by which it stands related to the healthy organism. In some sense, even, all food is medicinal, for it counteracts hunger, the first symptom of a disease which tends directly to death.

There is, however, a large number of substances which are used as medicines, and for no other purpose, and their qualities are not inaptly represented by the popular idea that a medicine is something which is offensive to the senses or distressing in its operation. All of the bitter medicines belong to this class; and many, also, which, by their very antagonism to the economy, excite its various organs to unwonted efforts, or restrain their excessive action, and thus become salutary in their effects. Among these we may rank emetics, purgatives, narcotics, &c. And so powerful is their action, in many cases, that,

if administered in larger quantities than experience warrants, they may become poisons instead of medicines.

There is no natural difference between a *medicine* and a *poison*. All medicines are not poisons, nor is every poison necessarily a medicine. But, with scarcely an exception, substances which, in a certain dose, are capable of destroying life, are also, in a certain less amount, competent to save life. Their deleterious action is only an excess of their salutary action; and, generally, the former is proportioned to the latter. In this, medicines but obey the general law under which a capacity for good is equally a capacity for evil. Light and heat, the vivifiers of the universe, would become the most powerful agents in its destruction were their operation uninterrupted and intense.

The illustration which has just been made use of suggests, further, the remark that there is a difference between a *medicine* and a *remedy*, in that the latter is the more comprehensive term. Light, mental influences, exercise, and diet, which are powerful remedies in certain diseases, are never included in the catalogue of medicines; while heat and electricity, which belong to the same class of natural agents as light, enjoy that distinction. Considered as material agents, they may, without impropriety, be comprised in the definition which has been given of a *medicine*.

Most of the natural agents just named are employed to prevent rather than to cure disease, and hence belong to the domain of *Hygiene* more than to that of the *Materia Medica*. The simple reference that has been made to them is sufficient to show that, to limit the resources of the physician to the use of drugs alone, is to adopt a very narrow view of the importance of his office.

There are still other remedies which are not medicines. The whole *armamentarium chirurgicum et obstetricum*, the instruments and apparatus employed in surgery and obstetrics, illustrate this statement. Their office is simply to afford nature a *mechanical* assistance in the performance of her functions.

MATERIA MEDICA, or PHARMACOLOGY, treats of the natural history and the preparation of medicines, and of their operation on the animal economy. It strictly includes PHARMACY, or the art of selecting, preparing, and compounding medicines; but this, which belongs to the apothecary as his special business, occupies only a subordinate position in a treatise which is addressed to the physician and the student of medicine.

THERAPEUTICS treats of the *action* and the *uses* of medicines in the cure of disease. It is *general* and *special*. *General Therapeutics* investigates the relations of medicines to disease in general, or of classes of

medicines to morbid states which are common to several diseases. *Special Therapeutics* considers the application of individual remedies to the cure of particular diseases or symptoms. In works which treat of the whole subject, the former division is discussed in chapters prefixed to the several classes of medicines, and the latter in connection with the several articles of the *Materia Medica*.

Works on Therapeutics are complementary to works on Practice of Medicine. In the latter, many remedies are examined from a point of view in a single disease; in the former, many diseases are examined in their relations to a single remedy. Either would be incomplete without the other, and he is the best practitioner of medicine who most constantly and clearly keeps before his mind the reciprocal dependence of the two great departments of the Art of Healing.

Sources from which Medicines are derived, and the Causes which modify their Virtues.—Medicinal substances are furnished chiefly by the vegetable, mineral, and animal kingdoms. They derive their virtues from active principles, each of which possesses a uniform composition, however variously it may be associated with other principles, and with inert matter, which modify its operation upon the system. In nature, a medicine seldom exists in a pure or isolated state; and, although chemistry has extracted what are called the active principles of many drugs, as quinia from cinchona, and morphia from opium, it has at the same time revealed that nature has associated with these principles certain others which, subordinate though they may be, are probably essential to the effects produced by the drug in its natural state. It is, perhaps, hardly less unwise to expect identical effects from a vegetable alkaloid and from the plant which yields it, than it was at one time to employ gelatin for food, as the representative of meat. In the latter case, nature vindicated her own laws by the disease and death of the victims of a short-sighted science; and, in the former, it will probably be found hereafter that the proper representative of a natural drug is a combination, in their due proportion, of all its active constituents. Medicines derived from the mineral kingdom are seldom used in their natural state, nor until they have been isolated from their chemical or mechanical associations. But the case is different in regard to animal and vegetable productions.

It is a familiar fact, that the immature plant or animal presents but feebly the qualities which distinguish its maturity. The flesh of the young animal is delicate and insipid, while that of the adult may be coarse and rank, and, when the sexual organs have become developed, may afford a medicinal substance which is altogether wanting before

this occurrence, and which is most active during the rutting season. The young plant and the recently formed portions of older plants abound in mucilage and other constituents, without active medicinal qualities, while the same parts, on attaining their maturity, furnish some of the most precious drugs, or acquire poisonous properties. The immature shoots of *phytolacca* (poke) are used as a vegetable for food, but the root of the full-grown plant is an acrid emetic and purgative. The flowers of many plants abound in an essential oil which cannot be procured from any other part.

By far the greatest number of active medicines derived from the vegetable kingdom are products of the torrid zone, or of countries which resemble this region in their temperature. There, the exuberance and vigor of life are extreme, and, under the blaze of a tropical sun alone, are elaborated those essential oils which give energy to a large class of medicines, and those narcotic and other principles which mainly affect the nervous system. The plants which furnish these potent remedies lose one-half their vigor when transplanted to a colder soil and climate. The hemp, which in Persia exudes a powerfully narcotic and stimulant juice, forms no such product in the colder regions of Europe and the United States; and the poppy, which in Turkey abounds in opium of the most active properties, furnishes a comparatively feeble product when transplanted to the south of France.

Differences of soil involve diversity of virtues in vegetable products. One rich in organic remains is unsuited to develop the virtues of a plant which is natural to a rocky or a sandy soil; and the algæ and mosses which grow by the sea-side have qualities very different from those of the dock and the sweet-flag, which thrive in fresh-water lakes and rivers. Such differences also in the soil, and in the deeper strata of the earth, produce a great diversity in the operation of mineral waters, which, in all ages, have been ranked amongst the most efficient remedies for chronic diseases.

THE SOURCES OF KNOWLEDGE IN THERAPEUTICS.

Experience is really, as well as rationally, the only ground upon which curative effects can be expected from medicines. All of the positive knowledge which is now possessed concerning them is the result of an accumulated observation of their effects, in some cases, during thousands of years. It would be curious, and not wholly un-instructive, to inquire how substances, which are not used for food,

began to be employed as medicines; whether man himself instinctively resorted to them, or only in imitation of the lower animals, which still devour certain plants when suffering with pain and various complaints.

The difficulty of accounting for the original discovery of medicines is recognized by all nations, and is expressed in the universal belief that the art of using them is a divine gift to man. Undoubtedly, the instinctive cravings which are often manifested in disease must have led the way to an experimental use of many substances resembling in their physical qualities those which were the object of desire; and thus man, who, like the lower animals, experienced instinctive longings, was led by his rational faculty, to make experiments, and to compare and analyze the results of his observation. It is not improbable that in proportion as he recedes from civilization, and lives without its artificial desires, his instinct becomes keener and more unerring in its indications. Yet, every day's experience shows that even in civilized life this singular power often possesses great energy. Every one has witnessed the intense desire for cold drinks usual in acute febrile diseases, the craving for acids in scorbutic affections and in some others distinguished by a diminished crasis of the blood, and also the longing for innumerable and widely dissimilar articles of food, many of them disgusting, or in themselves unwholesome, by pregnant females. The chlorotic girl who greedily devours plaster, and chalk, and charcoal, obeys an internal craving which is often explained by an excessive secretion in the stomach of an acid, which these substances absorb. And, as Albers has remarked, the selection which she will sometimes make of such articles is wonderfully fastidious. He met with children who relished charcoal made from box-wood, but not from oak, soft but not hard chalk, old but not new plaster; and we remember a young lady, of marked chlorotic aspect, whose unnatural appetite could only be satisfied by a certain ferruginous pebble, which she diligently searched for in the gravel-walk of her garden. While it cannot be maintained that instincts, of which these may serve for examples, always afford correct indications, it must still be admitted that they form one of the original sources of knowledge in the treatment of disease.

A still more abundant source is one which implies some degree of rational observation, viz., a study of the processes by which nature effects the cure of diseases, and an attempt to imitate her operations. One of the earliest remarks that must have been made by man was that certain evacuations, as bleeding, vomiting, purging, sweating, and urination, formed so many means by which diseases are cured; and by

instinctively attempting to imitate these processes, he established an art of medicine. The means of accomplishing his purpose were doubtless rude at first, and derived by imitation from the lower animals, or by an accidental experience of the powers of different agents. Thus we may suppose that heat was the first diaphoretic ever employed, because, on many occasions, its power of causing the perspiration to flow was manifest; and, indeed, we find that among savage nations the vapor-bath and other rude methods of sweating still form their leading method of cure. We may presume that the earliest emetics were those by means of which certain animals excite vomiting, or warm water, whose nauseating properties must very soon have been remarked.

But man, as a rational being, could not permanently remain contented with so limited an extent of knowledge; observation, comparison, memory, and tradition, which is the memory of nations, constantly enriched his medicinal resources, and determined more accurately their value. According to his natural genius, he gave to his knowledge more or less of a scientific form; and while some races, like the negro and the red man, seem never to have been capable of adding to or developing their original scanty stock, the Caucasian has evolved, from the primary elements common to all mankind, a science and an art of therapeutics second to none others in extent, variety, and usefulness.

Until the time of Galen, who lived in the second century of the Christian era, medicine hardly claimed the rank of a science—or a philosophy, as it was then termed—but contented itself with a diligent observation of nature and the results of experience. These were gathered and preserved by Hippocrates, Theophrastus, Celsus, Dioscorides, and Aretæus, and have continued to be the fountain from which later ages, even to the present time, have drawn their chief supply of therapeutical knowledge. But Galen claimed to create a science of medicine, in which every practical precept was deduced from some pre-established principle. By his commanding genius and profound knowledge he succeeded, at a time of general decay and feebleness, in imposing his dogmas upon the medical profession as a yoke for thirteen hundred years. During this protracted era of mental and material servitude, the primeval stream of science became completely choked by the rubbish of scholastic learning. But since the emancipation of medicine from its thralldom to the Galenic system, it has not often, nor for a long time, nor ever completely, become the slave of any doctrinal creed. For, although systems have succeeded systems, and Paracelsus, and Stahl, and Brown, and Rasori, and Hahnemann

have by turns arrogated to themselves the possession of infallible principles of therapeutics—some in honest but overweening faith, but others in fraud and falsehood—the advance of medicine has scarcely been retarded, for it has, in the main, adhered to observation as the direct road to scientific truth.

Therapeutics, in this respect, differs in no wise from the other natural sciences, which one of the greatest of living philosophers declares to be “founded upon a rational empiricism; that is to say, upon the totality of facts recorded by science, and subjected to the mental processes of comparison and combination.”¹ The same writer further tells us that the first step of the empirical process is to collect individual facts, arranging them according to their likeness or unlikeness, and then to add to these facts by experiment, by means of which we are enabled to study phenomena under different and determinate conditions, and thus ultimately to arrive at empirical laws. Such laws form the *principles* of therapeutics. They are nothing more than concise formulæ of the results of experience, and, therefore, when legitimately formed, are as far as possible from standing in opposition to experience. They rest upon a wider basis of experience than it is possible for any individual to possess, and in no other respect do they differ from the conclusions drawn by a single mind from direct and personal observation. But there is another and very objectionable sense in which the phrase “principles of therapeutics” is sometimes used. It is applied to propositions evolved by the application of hypothetical laws of the action of medicines to equally hypothetical pathological conditions. But since the changes which a medicine produces in the organism are so imperfectly known, it may be said, respecting those substances which most certainly cure disease, that we are ignorant of their action, even in the healthy body. On the other hand, we know little or nothing of what constitutes disease; that which we do know consisting of physical changes in the body, which are, indeed, the effects of disease, but not disease itself. How, then, we repeat, is it possible to deduce principles of therapeutics from a comparison of the action of medicines, of which we know little, with the intimate morbid actions of the system, of which we know still less? Yet upon such an unsubstantial foundation have been built all of the so-called systems of medicine which have been named above, and which have uniformly failed of success whenever they were brought to the test of experience in the hands of men who had no passions to gratify, and no foregone conclusions to sustain.

¹ VON HUMBOLDT, Kosmos.

But it is not a careless or a random experience which is competent to solve the dark and intricate problems of therapeutics. A clear understanding of the terms of any problem is the first and an essential step towards its solution. In the present case there is, upon the one side, man, but not a perfect animal organism. He has come into the world imperfect, with the deformities, the defects, the morbid tendencies of his ancestors; he has grown up under the most varied circumstances of climate, locality, &c., all of which have moulded his physical condition, and developed in him peculiar susceptibilities; he may be the subject of almost innumerable diseases, of various grades, in various combinations, and at different stages, and each one modified by his preëxistent tendencies. On the other side there is the medicine, varying in its effects with its origin and mode of preparation, its dose and combination, even in the same healthy organism, but infinitely more so according to the peculiarities of the patient and the disease with which he may be affected. It would seem almost impossible that the product of two such uncertain quantities should ever be foreseen, or, in other words, that therapeutics should ever attain to the certainty even of a rational art, or, still more, of a science. Although it is not a science, yet it involves a large number of scientific elements; for, as will appear in the sequel, in many therapeutic problems there are chemical or physical conditions which can be accurately determined, and it is probable that with the progress of investigation the number of these will hereafter be greatly increased. Nevertheless, the modifying influences of the causes already noticed and of many others are so powerful and controlling, that in practice it is seldom possible to foresee the precise result even when the mode of action of the remedy is approximatively known. As was before remarked, those remedies are most efficient whose action upon the economy is most obscure.

Before proceeding to consider more particularly the sources from which our knowledge of the curative power of medicines is derived, it is proper to premise what should be understood by the phrase to *cure* disease. The word to *cure*, in its proper and etymological sense, means "to take care of," and it is only derivatively that it has come to signify to heal or "to restore to a sound or healthy state." The distinction is happily expressed in the Latin line, *Medicus curat, Natura sanat morbos*, Physicians *cure*, but Nature *heals*. Medicine is only the handmaid of Nature, the really active and efficient agent in the restoration of health; Medicine can do no more than remove the impediments from Nature's path, support her when faint, restrain her when violent, and guide her when she is inclined to err. But the vital powers and functions of the organism have an inherent tendency to return to

their normal condition when deranged by any cause, and to remove or repair the alterations of structure which may have attended that derangement. In this consists the healing power of Nature, *vis medicatrix Naturæ*, which, under various names, was recognized even in the earliest ages of Medicine, and, indeed, more fully then than at any subsequent period until modern times.

In diseases the least amenable to art, as well as in those acknowledged to be spontaneously curable, the power of Nature is clearly manifested. It is not pretended that any human resources can secure the arrest of tubercle, yet Nature not unfrequently converts the tuberculous into a calcareous deposit, in which form it remains permanently innocuous. The highest achievement of art is to sustain nature, that she may have time, if possible, to perfect her work. The whole process by which wounds are healed is a natural one; and consists simply in the establishment of the nutritive process between the divided surfaces; of the exudation of a plasma and of cells, the formation of bloodvessels, and the absorption of the excess of material. And yet for thousands of years this simple method of nature was set aside by man's contrivance, and wounds were deluged with oil and wine and various unguents, which substituted suppurative inflammation for the adhesive process, and both aggravated and prolonged the patient's suffering. But if nature is so efficient in healing external lesions, we must presume that she exerts the same power in diseases of internal organs, for the elements involved are essentially the same in both. But even more than this, a little observation informs us what is the method she adopts to prevent the development or extension of morbid processes and to reduce their activity.

A great many diseases have their starting-point in the contact of an irritant with some portion of the organism; it may be a mote, a splinter, or something which excites a peculiar susceptibility in an organ; and in all of these cases we observe that an effort is made to reject the offending substance from the body. A particle of sand lodges upon the membrane that covers the eye; immediately acute pain occurs, the closed eyelids refuse to expose the irritated organ to the light, a flood of tears pours over the ball to wash the offending body away, the colorless bloodvessels become distended and tortuous and red, secreting mucus abundantly, and, if the irritant still remains, also forming pus. All of these changes are evidently exaggerations of the normal functions of the organ, which is so constituted for the very purpose of remedying those evils to which it necessarily is exposed. Its structure and function involve its possession of a conservative power over its own integrity. Or, again, a substance is taken into the

stomach which is insusceptible of assimilation, or which is capable of acting as an irritant of the gastro-intestinal mucous membrane. It tends to excite vomiting or purging, and is expelled from the body, or it merely augments the secretion of mucus which sheathes and protects the bowels. A splinter or other foreign body is lodged in the flesh; it usually excites suppuration around it, by which it is loosened from its connections, and on the opening of the abscess is discharged. Or, as in the case of a leaden bullet, the tissues around it become thickened and form a cyst which cuts off its communication with the rest of the body. Even in ordinary inflammation, the tendency to form an abscess, or at least to erect a barrier of coagulated albumen between the central seat of the lesion and the surrounding structures, illustrates the conservative operation of nature. For, let the powers of life have fallen so low that the required effusion of albumen fails to take place, diffuse inflammation of the cellular tissue ensues, and perhaps gangrene, terminating, if not in death, yet in irreparable injury to the organs involved.

Congestion, which is usually the first stage of inflammation, may occur as an isolated phenomenon, the result sometimes of local, and sometimes of general causes. It consists merely in the undue distension of the bloodvessels, and may be terminated by their giving passage externally to the blood itself, to serum, a constituent of the blood, or to mucus or some other proper secretion formed from the blood. And plethora, which is a general fulness of the bloodvessels, often threatening apoplexy, or a dangerous tension of various important organs, is frequently relieved spontaneously by bleeding from the nose, anus, or other part.

The doctrine of crises, which formed so capital an element of the Hippocratic pathology, and the one of all others which does not countenance a perturbative treatment, was a clear recognition of the sufficiency of nature to cure disease, provided that her efforts are untrammelled. According to this doctrine, all acute febrile diseases tend to terminate on certain days by discharges of blood, or mucus, urine, serum, sweat, &c.; or, in other words, whenever a cure occurs, it is effected by and through the proper powers of the constitution itself. In these diseases, also, we observe, on the one hand, an unwonted excitability of the nervous system which consists of mere restlessness, or which may rise to delirium and phrensy, and on the other, when a tendency to recovery is established, a disposition to repose and sleep, which thus provides a natural remedy for the overtaken brain. Nor should we forget that among the first symptoms of acute disease are pain, debility,

and loss of appetite, which are so many injunctions of nature to cease from toil, to seek repose and to abstain from food.

But while we may learn from these illustrations the reality of the part which nature takes in the cure of disease, and the wisdom of following rather than of attempting to lead her, it is equally true that there are cases in which prudence and moderation are commanded by an opposite motive, by the impotence of nature and even of art to avert a fatal termination.

Physicians are daily blamed for their inability to save the lives of the sick, and many of them, it is to be feared, do not clearly apprehend, or apprehending are unwilling to acknowledge, why such narrow boundaries limit the power of medical art. But the difficulty of forming just ideas upon this subject arises from overlooking, or not properly appreciating, the changes of structure produced by disease. When a man's brain is crushed, neither physicians nor even the vulgar expect to see him restored to health, and medicine incurs no blame for his death. But if the cause of death be a rupture of the heart or an effusion of blood in the central portions of the brain, the fatal result is just as inevitable. Yet the physician only can appreciate this truth; the layman does not perceive why these lesions should necessarily extinguish life, and he can scarcely repress the suspicion that some medical means ought to have been found to prevent the catastrophe which he laments. Other diseases accompanied with visible changes of structure, such as valvular disease of the heart, tumors which arrest the course of the blood or of the chyle through its main channels, and cancerous degeneration, the physician sees terminating fatally without anxiety or self-reproof, while the unlearned half hint that he or his art is responsible for the result. A step further, and doubts and difficulties assail the physician almost as much as the non-medical objector; nothing in the visible and tangible changes which the body has undergone can explain the fatal event, and when the propriety of the treatment and the skill of the physician are assailed, they cannot be vindicated to the complete satisfaction of the assailant, nor always of the physician himself. His conscience will suggest the questions: Could nothing more nor different have been done? would not a more experienced practitioner have been successful? And yet, in such cases, death may have been quite as inevitable as if the brain had been shattered, or the heart torn from its vascular connections. Blood of a certain composition is quite as essential to life as the integrity of any of the organs once expressively called *noble*; yet the nature, and still more the degree, of its alteration incompatible with life can be only guessed at. There is reason to

believe that many of the most prevalent and fatal maladies which scourge our race, are essentially constituted by a vitiation of the blood in its origin, or by the retention within the vessels of substances which are excreted in health. With our present means of research, these obscure and complex problems cannot be solved, and consequently the curability of such diseases can only be shown by the results of their treatment. The large mortality in cholera, yellow fever, and other pestilential maladies, does not form a just reproach to medical art; for the absence in them of organic lesions capable of explaining death, proves that a profound and mortal change, not fully cognizable by the senses, must take place in the vital fluids of the body, and agrees with experience in demonstrating that a large number of cases of these affections are inevitably, and from the onset, fatal. Laymen cannot be expected to have accurate information upon such subjects, and should abstain from expressing opinions respecting them; but if physicians themselves were sufficiently alive to the views here presented, they would neither, on the one hand, suffer pain for a duty ineffectually performed, nor, on the other, prescribe so much at random, as in desperate cases they are apt to do, or neglect to apply the appropriate remedy at the precise point of time when it is needed.

Between the two extreme classes above referred to—of diseases in which nature alone is competent to the cure, and those in which neither nature nor art avails to avert death—there is a middle class in which the skill of the physician, and the power of his art, are chiefly manifested. They are affections, some of which have little or no spontaneous tendency to cure—as goitre, syphilis, periodical malarial diseases, &c.—or else incidental states or phases of continued fevers, inflammations, and other non-specific affections. In these medical skill alone outweighs the power of disease and inclines the balance from death to life. On some of such affections appropriate remedies exert an unexplained, and, as it is called, *specific* virtue; in others the disordered function or altered structure can be restored to a healthy condition by means of medicines which possess a definite and intelligible mode of action. The greater number, by far, of medicines belong to the latter category, and in their use justify the saying that Medicine is the handmaid of Nature, not supplanting her mistress nor usurping her rights, but actively assisting her to maintain them. In very many cases, the patient is ready to perish from sheer feebleness, if unaided by art. When manual or surgical aid is required, this fact is almost too palpable to need illustration; when the malposition or relative size of the foetus would prevent its being born alive, the hand or the instrument

of the obstetrician preserves its life, and saves the mother from inevitable death; when a foreign body rankles in a wound, a sequestrum perpetuates lameness, a calculus renders existence insupportable, or an abscess destroys all rest, or, by pressure upon a vital organ, may put an end to life, the surgeon's instrument has the life-giving power of Ithuriel's wand. So the physician, by a timely use of the lancet, prevents the fatal effects of congestion of the brain, the lungs, or other important organs, cuts short inflammatory disorders in their forming stage, relaxes the unyielding uterus, &c. Less sudden in action, but not less real in power, are the physician's elixirs, in the numerous diseases at some stage of which the vital powers flag and faint; they arouse and feed the flickering flame of life until the crisis is past, and the strength of the system suffices for itself. In cases of chronic and incurable disease, his skill often avails to prolong life, and to restore, even if not permanently, a useful degree of vigor. It often happens, too, that by a timely treatment he arrests the formation of structural alterations which ultimately would prove fatal. So laryngitis is repressed before it produces asphyxia, meningitis before it occasions coma, endocarditis is palliated so that the heart does not become disorganized; the greatest dangers of typhoid fever, of dysentery, of some forms of dropsy, are immensely diminished by a timely and judicious use of medicines. By the same means, and in the same diseases, the natural process of cure is often expedited, for whatever limits the pathological process must shorten and simplify the steps which lead back again to health. Above all, it is in palliating suffering that the influence of medicine is most commonly recognized. It is evident that such must be the effect of whatever represses morbid action; but, independently of its influence on the substance (so to speak) of the disease, medicine is of infinite service in lessening the violence of the symptoms; for oftentimes, by their intensity alone, the powers of life become enfeebled, and at last succumb. Such symptoms usually are presented by the nervous system either primarily, or secondarily in consequence of the condition of the blood; and then narcotics, nervines, and sedatives, with depletion in certain cases, are found efficient in subduing fever, in assuaging pain, in allaying excitement and restlessness, and in bringing on the influence of "tired Nature's sweet restorer, balmy Sleep."

SOURCES OF KNOWLEDGE RESPECTING THE ACTION OF MEDICINES.

In studying the relations of a medicine to the cure of disease, two questions evidently claim precedence of all others. The first is, does the medicine really produce or promote the cure? and the second is, in what manner does it operate? The former of these questions can be answered by the results of experience alone; the latter may be solved by an analysis of the same experience, so as to detect the different steps by which the curative result is obtained, and, in addition, by means of experiments upon healthy persons and upon animals, so as to determine what is the essential action of the medicine employed.

As the whole object of medicine is the cure of disease, it is evident that direct observation of the effects of remedies in the treatment of disease must afford the most trustworthy information respecting the manner in which they induce the result. Such is, indeed, the method which has always been spontaneously followed by medical observers, who thus sought to learn under what circumstances a substance becomes a remedy. In this manner the greater number of drugs have been introduced into the *Materia Medica*. Nor is it at all probable that any advances which may be made in pathology on the one hand, and in a knowledge of the physiological action of medicines upon the other, will ever impair the fundamental truth that therapeutics must be learned at the bedside of the sick. But this is one of the most difficult branches of medical inquiry; for it is sometimes quite impossible to distinguish between the symptoms of a disease and the effects of a medicine. Among barbarous nations, among the ignorant classes of Christian countries, even among the educated and refined, and among physicians themselves, we may constantly witness a tendency to attribute all of the phenomena which follow the use of a medicine to its operation, and often to it exclusively, whereas the greater part of them belong to the natural or the perverted functions of the economy, and their degree alone is, in most instances, at all affected by the medicine that has been given. Even when the medicine sets up a new train of actions, these are, in general, nothing more than movements of the economy itself put into operation in such a manner as to produce a salutary result, so that the real and immediate curative influence is an effort of nature aroused by artificial means.

Clinical observation of the effects of medicines is in itself extremely difficult, and it is moreover liable to so many errors, that its results must be accepted with extreme reserve. The universal, not to say irresist-

ible, tendency to mistake a sequence for a consequence, which is above alluded to, is the primal source of these errors, and is apt to bias even the most conscientious observer. How frequently does the practitioner imagine that his prescriptions have induced the phenomena which belong to the development of the successive stages of a paroxysm of intermittent fever, or occasioned the resolution of a deposit which the recuperative powers of nature would have accomplished quite as speedily! How often does the patient's faith in his physician stand in lieu of all drugs! Not less fruitful of error is the pride of opinion, which, like a distorted or discolored medium, causes facts to appear unlike themselves, and inspires an obstinate adherence to error. From this the transition is short and easy to a positive and wilful misrepresentation of truth, to creating facts to sustain a theory, or to alleging results of treatment different from the true ones, perhaps the reverse of them entirely. With such defects in the evidence upon which our conclusions rest regarding the action and efficacy of medicines, it is no wonder that every year witnesses the introduction of new ones with extravagant encomiums, and the oblivion of others which had been heralded with equal eulogy. But the mere persistence of belief in the virtues of a medicine does not necessarily prove them to be real. The ancient *Materia Medica* comprised many substances which we know to have been either absolutely inert, or incapable of producing the effects ascribed to them, and they continued to be used in full confidence for hundreds of years on the authority of Hippocrates, or Galen, or other masters in the schools. Nor was it until the cultivation of the fundamental branches of medical science that they began to be required to give proof of the virtues they were asserted to possess, and it is only within a very few years that any systematic and accurate method has been adopted to discover their essential powers. This inquiry, it is true, has not only permitted many of the ancient remedies to maintain their place with undiminished reputation, but has even strengthened it by revealing and adding to the grounds upon which it rests. It has also enriched the healing art with a great number of new remedies whose value has been tested and confirmed by observations carefully made in many countries and under varying circumstances during a long series of years.

In pursuing this investigation, it is not the effects of a medicine in one disease alone which we can expect to reveal its peculiar virtues or its mode of action. Its apparent actions must be observed and compared in various diseases, at different periods also of the same disease, and, moreover, according to the doses in which it is administered. Whether or not this method will conduct to a knowledge of the man-

ner in which medicines cure disease may very well be doubted; but, what is more important, it determines, with all possible accuracy, the circumstances under which a particular remedy must be given to insure its appropriate effect.

It has often been denied, and by eminent authorities, that the rigid mode of analysis known as the "numerical method" is at all applicable to therapeutical inquiries. But surely this is an error. If experience has any value in therapeutics, it is because similar pathological conditions are constantly reproducing themselves, and are cured by the same methods of treatment. And if morbid conditions obey a law in their mode of development and decline, the medicines which more or less uniformly modify those processes must assuredly do so in virtue of an inherent law. If, therefore, the pathological conditions can be ascertained, it can also be determined under what circumstances they are influenced by medicines so as to terminate in health. To deny this would be also to deny that the effects of a medicine in disease can be anticipated at all, or that therapeutics is anything but guess-work. And, still further, it is not by the application of numerical analysis to the influence of particular medicines upon diseases regarded only as units that we exhaust its usefulness. For the greater number of diseases—nearly all, indeed—consist of a few definite changes in the blood or solids, producing symptoms which differ with the organ affected. Doubtless there are elementary conditions or lesions, however occurring, which are uniformly controlled by the same remedy; depletion everywhere modifies, at least, the forming stage of inflammation; mercury everywhere acts upon its products; opium in all cases assuages pain, &c. These uniform effects are determined by observation and the aggregation or addition of similar facts; and the more systematically they are ascertained, the more absolute will the results become. The latter class of general facts form the foundation of General Therapeutics, the former the laws of Special Therapeutics.

Hoffmann, brilliant theorist as he was, has shown in his writings that he knew what limits to impose on theoretical speculations, and that, whatever their appropriate field may be, it certainly is not therapeutics. "The primary and most solid foundation of therapeutical truth and medical judgment is," he remarks, "a detailed history of both patient and disease, in all points full and complete." And in another place he says: "There is no way of escape from the labyrinth of doubt created by controversy about the powers of different medicines, except by carefully and diligently consulting the records of cases

in which medicines have been found useful or injurious."¹ And two other great men of the same epoch have left a similar judgment upon record. "The whole philosophy of medicine," says Sydenham, "consists in working out the histories of diseases, and applying the remedies which may dispel them; and experience is the sole guide."² Baglivi's admirable treatise abounds in similar expressions. The peculiar aim of practice is, he remarks, "to adjust all the weighty concerns relating to the cure of diseases, pursuant to the laws of experience. He who pursues a contrary course, and forms his notions of practice from the rules of theory, will never be a successful practitioner."³

In spite of the warnings uttered by these and many other great men, the domain of therapeutics is, at the present day, continually trespassed upon by pathology, physiology, and chemistry. Not content with their legitimate province of revealing the changes produced by disease and by medicinal substances in the organism, they assume to dictate what remedies shall be applied, and in what doses and combinations. Their theories are brilliant, attractive, and specious, and they seem to satisfy a craving experienced by every reasoning man for an explanation of the phenomena which he witnesses; but, when submitted to the touchstone of experience, they prove to be only counterfeits. They will neither secure the safety of the patient nor afford satisfaction to the physician. Treatises which profess to furnish a method of treatment "deduced from the pathology" of a disease, are monuments of their authors' self-deception, and snares to those who seek in them reliable grounds of practice. The antiphlogistic treatment of pneumonia has often been cited as an illustration of the "rational" method in therapeutics. We are told that the first principle in curing an inflamed organ is to give it rest; but as there is no rest for the lung, reason requires us to diminish its labor by abstracting blood, and accordingly depletion is held to be the capital remedy for pneumonia, and experience has for centuries appeared to agree with reason in sanctioning this practice. But when once the natural cure of pneumonia had been studied, it became apparent that the loss of blood is very seldom essential to the patient's recovery, and that it is more generally mischievous than useful in any but the forming stage of the attack. In this stage, however, its utility is demonstrable. It is, moreover, explicable upon the ground that at this period the fibrinous effusion is slight and absorbable. Yet this pathological fact, though long known, availed nothing to modify the treatment of pneumonia,

¹ Opera omnia, i. 286, 291.

² Works, Syd. Soc. ed., i. 2.

³ The Practice of Physic, p. 132.

until direct experience illustrated and explained it; because a perturbative and spoliative method, presumed to be rational, was also believed to be more successful. It has been known from time immemorial that alkaline waters are useful in certain calculous complaints, and that iron is a specific for chlorosis; the principle of their curative action is of modern discovery, if, indeed, it is discovered. We are directed to use alkaline mineral waters to cure the lithic acid diathesis, because the base and the acid neutralize each other. Yet the very same waters are capable of curing the phosphatic diathesis. Is it then quite certain that they become curative by virtue of their alkalinity at all? Iron, we are assured, is a specific remedy for chlorosis, because it supplies an organic element which in this affection is deficient, viz., the coloring matter of the blood. Admitting the correctness of this explanation or not, the fact is none the more or less certain; its authority rests on the uniform testimony of physicians for thousands of years. There is not, we believe, a single example of a medicine having been received permanently into the *Materia Medica* upon the sole ground of its physical, chemical, or physiological properties. Nearly every one has become a popular remedy before being adopted or even tried by physicians; by far the greater number were first employed in countries which were and are now in a state of scientific ignorance; and even metallic medicines, which owe their introduction, as internal remedies, to experimental philosophers, gave no indication, however faint, of their peculiar virtues, until these were experimentally disclosed. No process of argument that ever was invented can establish a reasonable presumption that a medicine will be of service, unless its qualities have first been tested by its actual administration to the sick. Its taste and smell and other operations upon the healthy system may furnish ground for conjecture that it will be beneficial in certain morbid states, simply because these qualities recall those of other substances known by experience to be useful in the conditions supposed. We cannot impress too strongly upon the mind the fundamental truth that direct observation of the effects of medicines is the only possible foundation of therapeutics;¹ for, recognizing it clearly and following it reverently, we shall be content to concentrate all our powers upon nature, and listen to the responses which she makes to our earnest inquiries. We shall be content, by careful and prolonged, direct and comparative experiment and observation, to arrive at those practical conclusions which do not form the doctrines of a day or of a sect, but of all time and of the whole medical world.

¹ Non post Rationem Medicina inventa fuit, sed post inventam Medicinam Ratio quæsitæ est.—CELSUS.

If a direct analysis of clinical observation proves it to be the essential ground of therapeutical doctrines and precepts, an estimate of the value, in this relation, of experiments upon the healthy organism in man and the lower animals only strengthens the conclusion. The more extensively and accurately such experiments have been performed, the more evident does it become that the conclusions to be drawn from them can never serve as therapeutical rules, however they may throw light upon the manner in which particular medicines act upon the economy, and thereby furnish us with most valuable information respecting the limits of their power for good and evil.

The uniform action of a medicine upon healthy structure or function is its physiological operation; its curative action upon diseased structure or function is called its therapeutical operation. To determine the former is comparatively easy, for, as compared with the abnormal, the normal action of the system may be viewed as constant and uniform. But the latter involves infinite difficulty; for we are required to determine the influence of an agent upon functional and structural conditions, with the natural termination and tendencies of which we are only imperfectly or not at all acquainted. Whatever else they may do, experiments upon the healthy organism can never fully reveal the manner in which medicines cure disease, because in the latter case an element is involved which does not exist in the former. But if we are ever to acquire a distinct idea of the curative operation of medicines, that is, of their operation upon the tissues, organs, and functions, when they have departed from their normal condition, we must possess a standard with which to compare the effects that medicines produce; and, however imperfect it may be, no other standard is available than the operation of the same medicines upon the healthy economy.

But let us not suppose that even this method is exempt from difficulties and imperfections. The perfectly healthy constitution which the problem demands is seldom to be found; or else individual peculiarities exist which, unless the experiments are frequently repeated, require us to accept their results with circumspection. Age, sex, and constitution modify the action of medicines, and accidental circumstances, such as climate, season, and occupation, are not without their influence. To take but a single illustration: the doses of cathartic medicines which are habitually used in cold and temperate regions would be fatal in tropical climates. Idiosyncrasies, as they are called, peculiar and inexplicable susceptibilities, frequently modify, and even reverse, the ordinary action of a drug. Ipecacuanha in the smallest dose may occasion violent coryza, or the least quantity of mercury

excite ptyalism or produce nervous prostration; opium may induce wakefulness instead of sleep, &c. But these are exceptional cases, and while they should inspire us with a prudent scepticism in regard to the apparent effects of medicines when used in only a limited number of cases, they cannot seriously impair our confidence in the conclusions drawn from numerous and well-conducted experiments.

In disease it is different. In many affections, as in fevers, there is probably not a single molecule in the whole body which performs its function normally. In no two diseases, and frequently in no two stages of the same disease, are the aberrations precisely the same. It might, therefore, be anticipated that medicines would act differently in health and disease, and in the varying conditions of this latter. We can, with some confidence, foresee the effects of medicines in health, but in disease there is no experienced physician who does not feel uncertainty, and indulge in some self-gratulation when the result corresponds to his predictions. Let no one interpret this statement as an admission of the nullity of medicinal treatment. It would be as logical to regard life and health as worthless because nothing is more uncertain than the former, and because the very air we breathe, the food we eat, the clothing we wear, every action, every emotion, almost every thought, may be to us an instrument of death. The whole of life is a perpetual struggle with an enemy to whom we must at last succumb, and the wonder really is how often human skill, founded upon science and experience, has succeeded in postponing the inevitable catastrophe.

The difference between the operation of medicines in health and disease has been noticed ever since their actions were experimentally investigated. "The same remedy has a different effect," says Boerhaave, "on the sound man and the sick one. A prudent physician will not forget this, but remember that Galen has said, 'the prescription of a medicine is indeed under your control, but its effects are not.'"¹ The different modes of action of a plaster of cantharides upon the skin will illustrate this statement. The integument in its normal state will, under this operation, gradually become red, and then be vesicated; after which serum will be discharged, and then the part will heal. But the same plaster applied to the skin of a person in the cold stage of periodical fever, or in the collapse of cholera, will produce no impression at all. If applied to an erysipelatous part, on the other hand, it may excite violent pain, and produce intense redness, excessive swelling, and perhaps even gangrene. When, again, the cutaneous inflammation is local, superficial, and chronic, the very same

¹ Quoted by CESTERLEN from Comment., i. 9.

application may be salutary and effect a complete cure. Iron, which seems to exercise an almost creative power in renewing the exhausted and paralyzed functions of anemic persons, will, on the contrary, when it is used by those in health, impair the appetite, confine the bowels, and occasion headache and hebetude. Alcoholic stimuli can be taken by typhus patients, and by those affected with tetanus, in doses which would fatally intoxicate healthy persons. And the same is true in regard to opium in the latter disease. Stranger still, the wine or brandy which naturally excites the pulse and brain, heats the skin, flushes the face, and renders the eye wild, will, in the epidemic forms of petechial typhus, allay excitement, calm delirium, cool the skin, and change its dusky hue to a more healthy tint. Opium, which, in general, produces constipation of the bowels, is the most efficient means of relieving the obstinate constipation of lead colic. Tartar emetic is one of the most powerful medicines of the emetic class, yet when coma is present, or the nervous energy is otherwise oppressed or exhausted, large doses of this preparation may be used without effect; and, on the other hand, in the minutest quantities it will excite violent vomiting when the stomach is inflamed.

It is possible to explain not a few of these anomalies and apparent contradictions by the state of torpor which frequently affects some or all of the functions, and especially those of sensibility and absorption. The nervous system, in many diseases, responds feebly to stimuli, either because it is primarily impaired, or because the blood upon which its susceptibility depends no longer affords it the requisite vitality. In other cases, the hurry and irregular violence of its action arise from a similar cause. In both instances it is easy to conceive that a diffusible stimulus will restore the balance of the system by a direct action upon the nervous centres. Other apparent anomalies arise from the non-absorption of medicines. So in cholera, yellow fever, &c., mercurials may be administered in enormous quantities without producing salivation or any other constitutional effect. In the first-named disease the calomel which had been given has repeatedly been found unchanged in the stomach and intestines. Other cases, again, are explicable by a reference to what is known of the mode of the medicine's action. Iron is salutary in chlorosis because it supplies an ingredient of the blood which in that affection is deficient, and it is mischievous in health because it creates in the blood an excess of the same element. A blister will not vesicate the clammy skin of a cholera patient because the integument cannot absorb its active principle; it will occasion gangrene in an acutely inflamed part by rendering the physical changes in inflammation excessive and permanent; it will restore

one in a state of chronic inflammation by rendering the organic processes more active, and so performing a natural cure.

In nearly all of these, and similar anomalous cases in which it is possible to give a reason for the diversities of medicinal action, there is a substantial alteration of structure, of nutrition, or of the blood. But in many functional affections, *morbi sine materiâ*, the case is very different. In the whole range of remedies there is hardly one whose operation can with confidence be counted upon in certain functional diseases of the nervous system. Often it defies conjecture and sets at nought all rational anticipations.

There is a large amount of information, respecting the operation of medicines, to be derived from a study of cases in which they have been taken in excessive doses by mistake or with criminal intent. These display their operation in magnified proportions, as it were, and frequently reveal the alterations of structure which it tends to produce. They also serve better than the therapeutical action of medicines for comparison with the effects of these latter in experiments upon animals.

Such experiments are of great value, because they enable us to make a large number of comparative observations, varying the conditions at pleasure, so as to arrive, by exclusion, at those effects which are peculiar and essential to each medicine. We can also observe the different modes of their action according as they are administered by the stomach or bowels, applied endermically, or to the surface of wounds, injected into serous cavities, into the bloodvessels, &c. Further, we can in this manner learn the diversity of effects produced by various doses, degrees of dilution or division, and modes of combination of the several medicines. But more distinctly than in any other way we can thus discover the lesions which are produced in the body by medicines capable of acting as poisons, according to their dose, form, &c. Indeed, without such experiments nearly all of our ideas concerning the operation of medicines would be purely conjectural. It is true that they are not to be placed on an equal footing with similar observations made upon man, when these chance to present themselves; for while man can describe his sensations, we can only conjecture those of an animal by its agitation and functional disturbance. It is also to be remembered that many medicines do not affect man and the lower animals alike. They may be poisons to the former, and food to the latter. Hemlock, and water hemlock (*conium maculatum*, and *cicuta virosa*) are eaten in considerable quantities by cows without injury, but they are poisonous to man. Albers relates that he gave ten grains of pure morphia to a rabbit without producing any of the effects of

opium. To another he gave twenty-five grains of this substance without destroying it. Eight days afterwards he administered to the same animal a drachm of opium and ten grains of morphia. It lived, and gave no sign whatever of narcotic poisoning. Horses can take large doses of arsenic without injury, so large, indeed, says Albers, that they would destroy as many men as would weigh twice as much as a horse.¹ Infusion of quassia, which to man is a salutary tonic medicine, is extremely poisonous to flies, and destroys even dogs when injected into the veins. In herbivorous animals, as the rabbit, vomiting never occurs, while in carnivorous animals, as the dog, it is readily excited. Moiroud states that colocynth, jalap, gamboge, and bryony, which operate as violent purgatives on man and carnivorous animals, have comparatively little effect on the horse and other herbivorous animals. These curious facts are sufficient to enforce circumspection in examining the results of experiments upon animals, and to show that when we would make inferences from these latter to be applied to man, we must be sure that cases are comparable with one another. Of their value when properly conducted there can, however, be no doubt, or, if any one is still sceptical upon this point, let him reflect that the fundamental doctrine, or rather fact, of the absorption of medicines would probably not have been demonstrated without them.

In conclusion, while we desire to impress upon the reader that the scientific physician should first of all acquaint himself with the action of medicines upon the healthy organs, and, next should learn their comparative operation upon the same organs in disease, yet it cannot be too often repeated that the latter, or simple experience, forms the only crucible in which a therapeutical fact or doctrine can be fairly tried. Whatever sustains this test may be accepted as a real and permanent addition to our therapeutical resources. But the results of experiments upon the healthy organism cannot possibly attain to such importance; they can only illustrate the manner in which medicines cure disease, as physiology illustrates the phenomena which belong to the domain of pathology.

THE PHYSIOLOGICAL ACTION OF MEDICINES.

The operation of medicines may be studied under two heads: 1. The means by which they are brought into contact with diseased parts; and, 2. The modifications induced by them in those parts, and which

¹ Handbuch der allgemeinen Arzneim., Bonn, 1854, p. 1.

tend to restore these latter to health. The former constitutes the mechanism by which the medicine is enabled to operate, and includes its local action, the sympathetic phenomena it induces, and the phenomena accompanying its absorption and diffusion. The latter comprehends the vital, physical, and chemical effects produced by medicines, the manner in which they convert morbid into healthy action, and the influences which tend to restrain, augment, or pervert their operation. The one is a physiological, the other a pathological and therapeutical inquiry; but unless the phenomena and the laws revealed by the first are clearly apprehended, it is impossible to prosecute the second or to set a proper value upon its results.

The Local Action of Medicines.

The local changes produced by medicinal substances are those with which we are best acquainted, because in many cases they are open to our senses, and thus we are enabled to infer with strong probability that similar effects are produced by the same agents upon parts concealed from our direct inspection. We are at once struck by the fact that the local action upon a part is proportioned to its degree of vitality. If it be absolutely dead, no effect will be produced upon it by any other agents than those which act through their chemical affinity with its constituents. On the other hand, if its vitality be of a high grade, there will be a prompt, active, or even violent reaction. Between these two extremes every degree of susceptibility may be observed. To cite anew the illustrations which have already been adduced: in the cold stage of algid intermittent fever, or in the collapse of cholera, the most active irritants applied to the skin fail to awaken any sensation or produce any redness, but their appropriate action will be manifested as the integument regains its vitality. In those states of the brain which induce insensibility, the action of many medicines is impaired or suspended. So emetics and purgatives fail to operate during narcotism, deep intoxication, and congestion of the brain.

The nature of the substance itself also influences its local action. It may, like mucilaginous and most oily substances, have a purely negative influence, which, however, may become extremely valuable remedially, or it may be quite inert by reason of its insolubility, as is the case with many powders applied to the skin. Such applications are intended to limit the exhalation of a part and to protect it from irritation. But the nature of the part modifies still more sensibly the operation of medicines applied to it. In this respect the skin is much

less susceptible than mucous membrane. It is not only covered by the cuticle, an unorganized and insensible sheath, but its proper tissue is comparatively dense and unyielding, and less adapted than the mucous membrane to be penetrated by medicinal substances. It is, however, susceptible of inflammation by irritants, and to a peculiar effect of irritation, vesication, which consists in the secretion of serum by the chorion beneath the epidermis. It is often, also, attacked by caustics which enter into chemical combination with its constituents, destroying their vitality and organization. On the other hand, direct means are frequently employed to lessen the vital activity of the integument; such are cold, the great local antiphlogistic, and astringents, which also operate by repelling the blood from an inflamed part, and preventing the pain of its pressure and the morbid changes of nutrition it would otherwise occasion. Still other agents used as external medicines are cosmetics, resorted to for removing discolorations and slight eruptions from the skin, and depilatories, which usually consist of caustics capable of destroying the hair.

Medicinal substances are applied to mucous membranes either for the purpose of modifying morbid conditions affecting these latter, or for their remoter operation. In the former case, the same protective and irritant agents may be used as in the case of the skin, but as certain mucous membranes, those of the stomach and small intestine, for example, secrete liquids which may have a chemical reaction with the applied irritants, the operation of these latter may be greatly modified or completely annulled. Thus, when nitrate of silver is taken into the stomach, it is speedily neutralized by the secretions of this organ, and converted into chloride of silver, an innocuous compound. The greater number of medicines applied to the mucous membrane are intended to augment or to diminish its secretion. Of the former, purgatives and emetics may be taken as examples, and of the latter, astringents.

In studying the local application of medicines, we must not overlook their power of *penetration*. This is not identical with their absorption, a function which will presently be examined, but it is the power which medicines have of producing their effects, often energetically, upon neighboring but not functionally related parts. It is a universal custom to apply local remedies in the neighborhood of the affected organ, although no direct connection between the two points exists. That the operation is thereby rendered more powerful, admits of no dispute. A blister of cantharides, applied to the hypogastrium or the loins, will be much more apt to produce strangury than if it vesicated the breast or the neck. Strychnia has been

shown, by Albers, to occasion tetanic spasms much more readily when it is applied along the spinal column than when it is taken by the mouth, and when introduced into a wound in the former situation than into a similar wound upon the leg. Extract of belladonna applied to the eye, or in its neighborhood, will produce dilatation of the pupil more certainly than if it were taken internally, and the same remark is true of the application of this medicine to produce relaxation of the neck of the uterus, and of the sphincter ani muscle. If we wish to discuss an indurated gland by means of iodine or mercury, we apply them as directly as possible to the part affected, knowing that their internal administration would be much less effectual. It is customary to apply cups, leeches, blisters, cataplasms, &c., to the surface of the chest or abdomen when the lungs, heart, or bowels are inflamed, and their utility is unquestionable, although no direct connection exists between the seat of the disease and that of the medicinal application. In the last illustration the direction of the influence is reversed, but the principle is the same.

The Remote Action of Medicines.

The remote, secondary, or constitutional operation of a medicine is that which it produces elsewhere than at the part to which it is primarily applied. Thus, strychnia and cantharides are primarily local irritants, but remotely or secondarily the former is a stimulant of the spinal marrow and the latter of the urinary organs. In the greater number of cases a medicine gives rise to such numerous phenomena that it becomes a difficult question to decide how far they depend directly upon its administration, or are remotely occasioned by it. It is of necessity still more difficult to determine in what manner the effect is produced. The remote operation of medicines can only be effected through one or the other of two channels, the nerves or the bloodvessels, since these are the only known media of communication between distant organs of the body. There are those who maintain that the one or the other of these is exclusively the channel through which the medicinal influence is transmitted; but as in their physiological and pathological relations we know that both maintain a reciprocal influence between the several parts of the body, it may be presumed that both partake also in diffusing the curative operation of medicines. Direct observation confirms this view of the subject, although it shows at the same time that the two agencies are not of equal importance, and that the greater number of therapeutical actions

are due to the introduction into the blood of medicinal substances, which are thereby conveyed to every part of the body.

But many nervous phenomena are produced by medicines which, for that purpose, at least, are not required to enter the circulation. Many local irritants, including electricity, produce a disturbance of the nervous force, manifesting itself by a spasmodic action of the muscles. The phenomena of emesis and catharsis, including nausea, colic, retching, tenesmus, vomiting, and purging, often depend upon a purely local reaction between the medicine and the gastro-intestinal tube.

The spasmodic closure of the larynx against the entrance of chlorine, ammonia, and carbonic acid; the spasm of the respiratory muscles produced in some persons by the emanations of ipecacuanha; the vomiting excited by the passage of a biliary or vesical calculus; the nervous exhaustion occasioned by intense pain, and by the "shock" of severe accidents in which a limb is crushed, or a large portion of the body burned or scalded; the fainting and even death which sometimes result from sudden and agonizing mental emotion; these are some out of the many illustrations that might be adduced to show how powerful are the actions which may be aroused through the nervous system alone.

Other impressions are occasioned by the local action of medicines upon the nervous trunks or extremities, without the intervention of the circulation, as in the *penetration* noticed above. Anodyne and anæsthetic applications, such as opium, belladonna, veratria, and aconite, may relieve local pain without affecting the general sensibility. A frog's foot, kept moist with laudanum or prussic acid, loses its power of motion without the general sensibility having been impaired. Lemberg states that in a case of paralysis from lead affecting the upper limbs, he applied a blister to both arms, and dressed one of the sores with strychnia. The paralysis on this side improved, but on the other it was unaffected until a similar treatment had been made use of. In all these cases, the limited operation of the medicine seems to be unquestionable.¹

In 1822, Dr. Hubbard performed a variety of experiments with prussic acid and nux vomica, in which, it is stated, these agents were applied with much less effect to bloodvessels than to nerves, and that their action was proportioned to the importance and extent of the nerves involved.² Dr. Pennock drew an identical conclusion from

¹ SCHULTZ, Allgemein. Pharmakologie, p. 96.

² Phila. Jour. of Med. and Phys. Sci., iv. 242.

his own carefully conducted experiments;¹ and Dupuy and Brachet, without going so far, at least concluded that the division of the par vagum on both sides greatly diminished, if it did not neutralize, the poisonous effects of nux vomica and of narcotics introduced into the stomach. But these results are in direct contradiction with those of the greater number of observers. Fontana applied the venom of vipers, *ticunas* poison, water and oil of cherry-laurel, and opium, to the exposed sciatic nerves of rabbits and frogs, without producing any characteristic symptoms. He also tore and cut the same nerves without any notable effect. Wedemeyer obtained the same negative results by the application of prussic acid to the median nerve of a cat, in the space of two inches, and also to the infra-orbital nerve and the par vagum of a horse.² On the other hand, when poisons are introduced into a limb whose nervous connections with the trunk have been entirely severed, the same effects ensue as if the nerves remained entire. This is proved by the experiments of Magendie and Delille, who destroyed animals by means of *upas tieuté*, introduced into a limb whose only connection with the body was through an artery and a vein; and, lest it might be objected that the parietes of these vessels transmitted a nervous impression, or otherwise conveyed the poison, the experiment was repeated with the substitution of quills for the bloodvessels. Thus we have positive and negative proofs combined, that the nerves do not convey to their central organs any specific impression of the poison employed. But even did the specific effects of the poisons used in cases of ligature of the nerves develop themselves in some degree, it must be recollected that nervous trunks are absorbing tissues. A similar criticism is applicable to those cases in which the passage of poisoned blood through a vein is prevented by a ligature. If the constriction of the vessel is sufficient to cut off its circulation entirely, and even through its nutritious vessels, its nervous filaments must also be incapable of conveying impressions.

If the remote action of medicinal substances depended only on the local impression of the latter, the two would always be proportioned to each other; but, as Spillan has remarked, in the case of arsenic and other irritant poisons, when they destroy life by at once powerfully depressing the nervous system, the gastric symptoms and lesions are comparatively slight; while the suffering is most severe and the disorganization of the stomach is greatest when the nervous symptoms are less prominent. In this illustration, and in all cases in which a

¹ Am. Jour. of Med. Sci., ii. 9.

² ALBERS, Allgem. Arzneim., p. 228.

powerfully irritant agent is used, it is important to distinguish between the phenomena which it occasions as an irritant and those which depend upon its peculiar properties. Thus, arsenic and cantharides equally produce symptoms of violent inflammation of the organs of deglutition and of the stomach, but the Spanish fly occasions severe genito-urinary symptoms, which are absent in the other case.

It has been alleged in favor of the doctrine of sympathy that the phenomena produced by certain poisons occur with a rapidity that can only be explained by the transmission of nervous influence. But this argument rests upon a double misconception, first, of the time which actually elapses in the experiments referred to, and, second, of that required for a substance to reach the nervous centres through the circulation. There must evidently be a probability of error in estimating the duration of a very short period, during which the mind is intently occupied and highly excited by the phenomena expected, or actually occurring. When precautions have been taken to avoid this error, the interval has been found to be longer than was suspected. Thus, Dr. Blake states, that after half a drachm of concentrated prussic acid had been poured upon the tongue, eleven seconds elapsed before any morbid symptom appeared; and that it required fifteen seconds to develop symptoms of poisoning by injecting ten drops of conia saturated with hydrochloric acid into the femoral vein of a dog. And by the same experiment it was proved that the time required for diffusing a soluble substance through the body may not exceed nine seconds. Now it can hardly be supposed that a less period would be required for the poison by penetration to reach any nervous trunk or expansion capable of transmitting its influence to the nervous centres. Hering, of Stuttgart, has also shown, by experiments with the ferrocyanide of potassium, that this substance may complete the whole circuit of the blood within twenty or thirty seconds. In this connection the experiment heretofore referred to must be noticed, viz., that a frog's foot soaked in prussic acid became insensible, but the system remained unaffected.

Some writers who maintain the exclusive operation of sympathy in the mutual relations of remote parts cite with satisfaction the experiment of Morgan and Addison, in which a carotid artery of one dog having been made to interchange its current with the corresponding artery of another dog, one of the animals was poisoned by inoculating it with a concentrated solution of strychnia. It died in seven minutes with characteristic tetanic symptoms, while the other dog manifested none of the effects of the poison. But it is to be observed that a very small portion, comparatively, of the blood of the poisoned ani-

mal could have found its way into the sound one, because the circulation in the former began immediately to languish under the influence of the poison; and, moreover, that it was arterial and not venous blood which was transfused, and therefore not as highly charged as this latter with the poison. Besides these reasons, a more convincing one is the positive experiment of Vernière, who found that the venous blood of an animal poisoned with nux vomica, when injected into the veins of another animal, occasioned the same phenomena as occurred in the first instance. He also states that leeches are killed by the blood of an animal poisoned with the same substance.¹ In a case of poisoning by oxalic acid, Dr. Arrowsmith saw a number of leeches applied to the epigastrium die after they had drawn but a short time.²

It is also alleged against the doctrine of absorption that the fœtus in utero is not affected by a poison which destroys the mother. It is difficult to obtain reliable facts upon which to form an opinion respecting this subject, because the degree to which the child is influenced, when both it and the mother survive poisoning, cannot be determined. But it is very certain that some slow poisons do affect the unborn child. This is evidently the case with ergot during the epidemics produced by its admixture with flour made into bread; and a fœtus may be born with smallpox, although the protected mother has escaped the contagion. Two cases of the sort are related, the one by Jenner, and the other by Mr. Aulsebrook.³

On reviewing the illustrations that have now been adduced, it will, we think, appear probable that those medicinal agents alone act exclusively or chiefly through the nervous system which directly excite one of its functions, whether it be intelligence, emotion, the special senses, general sensibility, or motility. The number is indeed comparatively small of those which operate in this manner. Of internal medicines there are very few, if we except a limited number of purgatives, which do not operate by the means which we propose in the next place to describe.

Absorption.

After the discovery of the lacteals, and the experiments of Sanctorius on cutaneous exhalation, the idea of the absorption of medicines and their dissemination through the body, began to be entertained. As late as 1763 Dr. Wilkinson thought it necessary to

¹ Jour. des Progrès, iii. 121.

² CHRISTISON on Poisons (Am. ed.), p. 176; Med.-Chir. Trans., i. 269.

³ Br. and For. Med.-Chir. Rev., xvi. 265.

adduce a number of instances, of a striking kind, for the most part, to prove the reality of the absorption of medicinal substances by the skin.¹ The experimental investigation and demonstration of the subject dates from the period mentioned, and in the first year of the present century a thesis was published in this city containing a full enumeration of the proofs then existing of the important doctrine of the absorption of medicines.² However interesting it would be to trace the gradual development of this now fundamental doctrine in therapeutics, we forego that pleasure and proceed at once to illustrate it.

The proof that medicines are absorbed consists mainly of their being found associated with the different constituents of the body.

The poisonous properties imparted to the *blood* by several substances have been already noticed. The admixture of foreign substances is also detected by the smell and color of the blood, and by means of chemical tests. The discovery of foreign substances in the blood is attended with great difficulty, and this is no doubt a reason why their presence has been denied by some experimenters. But these negative statements could at no time outweigh the positive evidence which had been adduced, and the latter is now so abundant as to place the subject beyond the pale of controversy. A list of nearly forty substances, including the metals and metalloids, various salts, coloring matters, acids, essential oils, and odorous principles, thus detected, is given by Pereira, and it would be easy to enlarge it. When we consider how large a portion of these substances must be excreted, and how many remain in combination with the solid portion of the organs, and the new combinations which they form with the organic matters of the blood, or with other substances accidentally present in it, the wonder is that their presence should ever have been discovered at all. Mineral and saline substances are detected by chemical processes, but vegetable matters by their odor and by the color which certain of them, as indigo and rhubarb, impart to the serum; still, as a general rule, the coloring principle is either not absorbed, or not in sufficient quantity perceptibly to tinge the serum of the blood, although it may be found in the sweat and urine, and even in the bones. The odor of camphor, musk, alcohol, Dippel's oil, garlic, turpentine, assafoetida, oil of mustard, and oil of savin, has been detected by different experimenters. Many of these substances have been recovered from the

¹ Medical Museum, Lond., 1763, p. 117.

² An Attempt to prove that Certain Substances are conveyed unchanged into the Circulation, by EDWARD DARRELL SMITH, of Charleston, S. C.; CALDWELL'S Theses, p. 229.

blood unchanged, but it does not follow that the whole quantity absorbed was likewise unaltered. (Mitseherlich.)

The absorption of foreign substances, and their presence in the *chyle*, have been demonstrated in the case of various soluble coloring matters, owing to the natural absence of color in this liquid. It was early stated by Musgrave and by Fordyce, that indigo and sulphate of copper are thus absorbed, and the same result was obtained by Milnor; but Tiedemann and Gmelin, as well as Lawrence and Coates, were unable to detect the presence of any vegetable coloring matter in these vessels. But Maenevin showed that they absorbed hydrocyanate of potassa, and Coates, Lawrence, and Harlan, the ferrocyanate of potassa. In the first case the chyle gave a deep blue color with permuriate of iron, and in the latter with the sulphate of iron.¹

Medicinal substances are found impregnating the *solids* also. The flesh of animals used for food acquires a degree of bitterness, if their fodder contain bitter herbs, or it may become poisonous if they have eaten certain noxious substances. Thus, pheasants, which feed upon laurel berries, are believed to be poisonous, and the same is true of animals that have been poisoned with strychnia, arsenic, or belladonna. Humboldt and Bonpland relate that children who ate the fruit of *gustavia spinosa*, became all over of a yellow color. Some persons who have long taken nitrate of silver for epilepsy, have a bluish or slaty hue of the skin. Of this we have seen two instances, the one in a male and the other in a female; and numerous others have been reported by Swediaur, who first noticed the fact, and by Roget, Bertini, Badely, Vetch, Rayer, Lelut, and Wedemeyer.² In the Breslau Museum, the spinal column of a man who had formerly taken large quantities of mercury is to be seen, containing metallic quicksilver. A similar specimen is said to be in the Strasburg Museum. Albers found metallic mercury in the abdominal cavity, and in the intermuscular cellular tissue, after incision of the abdomen with mercurial ointment. Lead has been detected in the brain, the spinal marrow, the lungs, the liver, and the muscles of parts paralyzed by this metal. Copper, tin, antimony, zinc, and other metals, have been obtained from the liver. In many cases it appears that the metals have affinities for particular organs; as, mercury for the medullary portion of bones, copper for the muscles, and lead for the muscles and the brain. It is also stated that the metallic compounds with oxygen become partially deoxygenized when they are deposited.

As the *urine* is the vehicle by which a large portion of the effete

¹ BECK, Am. Journ. of Med. Sci., Jan., 1844, p. 30.

² Ibid., p. 39.

matter of the body is carried away, it might also be expected to contain a portion, at least, of the substances which are not assimilated by the economy. It was early known that the urine is colored, or has its taste or smell altered by various articles of food, and by several medicines, and also that these effects are sometimes produced even by the contact of certain substances, such as turpentine and garlic, with the skin. The effect of alkalies in calculous diseases was attributed to their absorption, and iron was detected, by means of nutgall, in the urine of persons taking the former medicine.¹ The subject has now been sufficiently investigated to render unquestionable the general fact above stated, and also to determine many laws which affect the elimination of the constituents of the urine.

The earliest series of experiments to elucidate this subject were those of Wöhler, in which dogs were used, and their results have, in the main, been confirmed.² Corresponding experiments were performed by Tiedemann in the case of a young man affected with exstrophy of the bladder, so that the urine could be collected and analyzed at the moment of its issuing from the ureters.³ A case of similar malformation enabled Mr. Eriksen to make experiments of the same kind, and with closely analogous results.⁴ The period required for the appearance of different substances in the urine varied from one to forty-five minutes. It now appears that many are excreted with the urine unchanged, including the chlorate, carbonate, and nitrate of potassa, and the iodide and ferrocyanide of potassium, vegetable coloring principles generally, and oil of almonds. Many odorous principles, such as those of turpentine, asparagus, valerian, castor, and assafoetida, become modified by secretion with the urine. The vegetable acids appear in combination with an alkali, and most of their salts as carbonates. The condition of the excreted mineral acids has not been fully determined, nor that of the metals, the presence of all of which in the urine has, however, been ascertained. Iodine appears as hydriodic acid or an iodide, and sulphur as sulphuric acid and sulphuretted hydrogen. Quinia, morphia, and the narcotic principles of belladonna, stramonium, aconite, and conium, are also excreted. Runge states that the urine of a dog poisoned by stramonium occasions dilatation of the pupil, when applied to the eye of a cat, and this statement is confirmed by Casaseca.⁵ Allan found daturia in the renal secretion, and Dr. Letheby states that the urine of animals poisoned by opium,

¹ E. D. SMITH, loc. cit.

² Jour. des Progrès, i. 41, ii. 99. (1826.)

³ New York Med. and Phys. Journ., vi. 129.

⁴ Am. Journ. of Med. Sci., Oct. 1845, p. 427.

⁵ ORFILA, Toxicologie, 5ème éd., ii. 307.

belladonna, hemlock, aconite, &c., contains the active principle of these substances.¹ *Agaricus Muscarius* is a fungus employed by the Kamtsehatdales, Samoyedes, and other tribes of northern Asia, to produce intoxication, and it is said that the urine of those who have used it becomes intoxicating in its turn, and that this influence may be transmitted to four or five persons in succession.²

In the *perspiration* have been detected the odorous principles of musk, garlic, assafoetida, and camphor, and the coloring matter of indigo, rhubarb, and saffron. Sulphur causes the body to exhale an odor of sulphuretted hydrogen, and to blacken articles of silver and gold worn near the person. Sulphur baths blacken the skin of persons who have been taking mercury or lead for a considerable time, forming a sulphuret with these metals.

There is a difficulty in determining the exhalation of substances with the *breath*, because, if swallowed, they are apt to impregnate the mucous membrane of the mouth and pharynx, or their vapor escapes by eructation. But when animals that do not vomit are used for experiment, and the medicinal substance is introduced by means of a tube into the stomach, the sources of error are diminished. By such experiments upon rabbits, Mitscherlich found that the odor of alcohol, ether, fusel oil, fennel, and caraway oils, of oil of turpentine, juniper, mustard, and savin, could be detected upon the breath, and more strongly after the lapse of half an hour than at first. But when the substance is introduced by other channels, the evidence is more conclusive. If phosphorus dissolved in oil is injected into the pleural or peritoneal cavity or into the veins, the animal exhales white vapors which are luminous in the dark. Lawrence, Harlan, and Coates found that tincture of assafoetida thrown into the peritoneal cavity or the intestine of an animal was perceptible on its breath, and a similar effect has doubtless been observed in man by all physicians after exhibiting assafoetida by enema. We have known a patient to complain of its taste in the mouth after this mode of exhibition. The breath is also tainted by camphor, garlic, musk, turpentine, sulphuretted hydrogen, alcohol, and other odorous substances injected into the veins of animals.

The influence of various kinds of food upon the *milk* is notorious both in regard to quadrupeds and the human female. The color, taste, and other qualities of cow's milk and butter are well known to depend upon their grazing or fodder, and the bowel derangements of nursing infants are very often traceable to acid or ill-digested food used by the mother, or to causes affecting her temper or comfort. It is quite

¹ Lond. Med. Gaz., Jan. 1847, p. 153.

² MURRAY, *Apparat. Medic.*, v. 557; MERAT and DELENS, *Diet. de Mat. Méd.*, i. 219.

as certain that purgatives given to the mother act upon the bowels of the infant, that opium operates through the same medium, and that mercury administered to the mother will cure syphilis in the child. The same transmission is eminently true of iodine and iodide of potassium, of bicarbonate of soda, and sulphate of potassa. Lead, iron, zinc, bismuth, and arsenic have also been detected in the milk.

But few foreign substances are found in the *saliva*, which, it must be recollected, is a secretion elaborated for the use of the economy, and not therefore fitted for conveying away unassimilable materials. When, however, the system is saturated with iodine or lead, these metals may be detected in the saliva. Some observers have reported the existence of mercury in it during salivation by this medicine, but others have searched for it unsuccessfully.

The observations and experiments which have now been described leave no possible doubt regarding the reality of the absorption of medicinal substances; for, after having been introduced at one part of the body, their operation may be suspended or moderated by ligatures or other pressure, and they may disappear from the place of application and make their appearance at another and remote one, many of them having undergone no change, while others, on the contrary, have been decomposed and formed new combinations. We have also seen that cantharides occasion strangury and otherwise derange the urinary organs, whether they are taken internally or applied to the skin; many purgatives, emetics, narcotics, &c., produce the same effects whether they are applied endermically, or taken into the stomach, or injected into the veins, and alkaline baths suspend or reverse the normal acid reaction of the urine. Indeed it is difficult to understand how any other view than one involving the absorption of medicines should ever have been regarded as exclusively true. As soon as it was known that the body grows by the absorption of food, it seems incredible that there should have been any doubt that medicines are taken in like manner into the system, and more especially that there should have been any after the discovery of the circulation of the blood. But in this case, as in others, time had gradually hardened into an inflexible body the accepted belief of many centuries; and, as it could not at once be bent or moulded anew, it was perhaps, too soon, destroyed. Yet it is strange indeed that two hundred years should have been required to accomplish so necessary a result as the substitution of the doctrine of absorption for that of sympathy.

Is Absorption performed by the Veins or Lacteals?—A knowledge of venous absorption is attributed to Celsus and Galen in the case of

poisons, and certainly the latter ascribed chylous absorption to the veins. After the discovery of the lacteals, these vessels gradually became invested with the function in question, and the belief that it belonged solely to them was established fully by the experiments of Hunter, Hewson, and Cruikshank.

Hunter withdrew a loop of intestine from the abdomen of an animal, filled it with milk, and then, having first inclosed it between two ligatures, and emptied the veins by puncture and tied the mesenteric artery which supplied the loop, he returned it into the abdomen. After the lapse of half an hour it was examined; the veins remained empty, but the lacteals were distended with milk. Similar experiments were afterwards performed with a solution of starch mixed with indigo or musk, and gave, it is said, analogous results. As early as 1791 Flandrin repeated these experiments, and in no instance detected the coloring matter in the lacteals, but observed that in very fat animals these vessels had a bluish tinge. Hallé and Fourcroy were equally unable to confirm the original observation upon this point, and so, still later, were Tiedemann and Gmelin. Drs. Harlan, Lawrence, and Coates, of Philadelphia, also concluded from their experiments that "coloring matters are not absorbed by lacteals in the living body."¹

Of various odorous substances, assafoetida only was doubtfully recognized by its smell in the lymph. These observers, however, detected prussiate of potassa in the thoracic duct by means of the blue color produced on the addition of sulphate of iron.² The general bearing of the evidence in regard to the absorbent function of the lymphatics is, that these vessels convey a portion of the products of nutrition into the general sanguineous circulation, at the point above mentioned, near its central organ, but that they do not take so large a part in the conveyance of inorganic and medicinal substances generally. And yet that they are not without a share in this office is proved by the following decisive facts. Wagner mentions that the axillary glands of a subject, brought for dissection, were found of an intense red color, from the deposit of cinnabar in their texture, while on the arm was a red tattooed figure of old date, which had evidently furnished the material.³ It is a familiar fact, first fully demonstrated by Ricord, that pus from a syphilitic bubo will engender syphilis if inoculated; and the same is true of glandular abscesses in other contagious diseases. But these effects are inexplicable unless we suppose the morbid virus

¹ Philad. Journ. of Med. and Phys. Sci., iii. 284.

² Ibid., v. 347.

³ TODD and BOWMAN'S Physiology (Am. ed.), p. 619.

to be conveyed from the original seat of the disease and deposited in the glands.

But while the share of the lacteals in absorbing non-nutrient substances is at least comparatively small, both by reason of their peculiar function and of their minute dimensions, the proofs that the veins possess this power are numerous and convincing. We were indebted for them originally to the ingenuity and skill of Magendie, who first published an account of his experiments in 1810. He at once took the ground that all absorption, except that of the chyle, is performed by the bloodvessels. In this, as we have seen, his original doctrine was too exclusive. The later discoveries of Dutrochet, relative to the permeability of membranes, pointed to the mechanism by which soluble substances are enabled to enter the circulation. Magendie showed that tincture of *nux vomica* applied to a vein, completely isolated by means of a card placed behind it, produced the eharacteristic symptoms of poisoning by this substance, in the course of a few minutes. When an artery was treated in like manner, the result was the same, but occurred more tardily. Mayer, within three minutes after a solution of prussiate of potassa was injected into the air-tubes of an animal, detected its presence in the left ventriole of the heart, but not in the right. If the absorption of the liquid had taken place by the lymphatics, it would have shown its presence first upon the right side of the heart into which these vessels empty.¹ In this connection also must be eited the well-known experiment of Magendie. The limb of an animal remaining attached to its body only by an artery and vein, a ligature was placed upon the latter, and strychnia applied to a wound in the limb. No symptoms of poisoning were manifested until the ligature upon the vein was removed, but on this being done, characteristic effects were immediately developed. A similar experiment, in which prussic acid was the poison employed, and the intestine of a horse the part to which it was applied, was performed by Panizza with identical results.² Sir E. Home tied the thoracic duct of a rabbit at its entrance into the subclavian vein, and gave the animal a strong infusion of rhubarb. An hour and a quarter afterwards the urine showed evidences of the presence of the medicine. Magendie performed the same experiment, with this difference, that he injected a strong solution of upas tieuté into the peritoncal cavity. The effect was quite as rapid as when the duct remained free. To these experiments others might be added, particularly those of Dr. Nathan Smith, at Philadelphia,

¹ ALBERS, op. cit., p. 221.

² Am. Journ. of Med. Sci., Jan. 1844, p. 187.

in 1827, showing that the lymphatics of the stomach do not absorb a solution of prussiate of potassa, but that it enters freely into the veins.

On the whole, it is evident that, although both lymphatics and veins absorb medicinal substances, this office belongs principally to the veins. Not only are these latter vessels vastly more capacious than the former, but, considering that the quality of the fluid circulated by them is so much denser than that which traverses the lymphatics, it might naturally be inferred that the veins are best adapted for conveying non-assimilable, and therefore comparatively gross substances. The lacteals are evidently intended to elaborate the products of digestion before they enter into the blood; but it would answer no good purpose, that we know of, for medicinal substances to undergo this operation. These, we repeat it, appear to be absorbed in by far the greatest proportion by the veins.

CONDITIONS FOR THE ABSORPTION OF MEDICINES.—As a rule, substances in solution are alone absorbed. They are either administered in this form, or they become dissolved in the *primæ viæ* by the operation of the gastro-intestinal secretions. In so far as the activity of a medicine depends upon its solution, it is evident that, if administered in the solid form, so much of it only will affect the economy as shall be rendered absorbable by being dissolved in the secretions of the stomach and bowels. The residue will act as a foreign body, and will either be discharged with the *fæces*, or, remaining partially behind, it may increase by repeated doses, and at last become a mechanical impediment to digestion. So magnesia, carbonate of iron, and mustard seed have been known to form large intestinal concretions. In view of this inconvenience and danger, it has been proposed to administer all medicines in such a state of solution as will insure their direct absorption without precipitation. But, apart from the practical difficulty, if not impossibility, of securing this latter condition, it is probable that no state of solution is so favorable to the absorption of a medicine as its union with the organic solvents it meets with in the body, and that no other solvents will be so apt to produce a solution as well adapted to the purposes of the economy as those referred to. Thus calomel, given as a purge, which it certainly does not become by virtue of any merely irritant properties, has an action which cannot be imitated by the use of any soluble salt whatever of mercury.

It has been supposed that minutely divided, but insoluble substances, are to some extent capable of absorption. So *Æsterlen*¹ administered

¹ Arch. Gén., 4ème sér., xvii. 472.

to rabbits, a cat, and two pullets, very finely pulverized charcoal mixed with water and their food. After the animals had been thus fed for a week, they were killed, and under the microscope, particles of charcoal were found in the blood of the mesenteric veins and other veins of the trunk. These experiments were repeated by Menzonides, who likewise detected the particles of charcoal, especially in the lungs.¹ But Mr. Headland, who, however, did not employ charcoal in his experiments, came to the conclusion that "no insoluble medicine can in any way gain entry into the blood without first undergoing solution in some way or other."² And Mr. Lister, who used indigo, carmine, and flour of sulphur in his experiments, declares that none of these substances enter the *lacteals*.³ It is probably true, for all practical purposes, that insoluble substances are not susceptible of absorption, even if we should admit the accuracy of Oesterlen's observation. But what, after all, is solution but a minuter division of particles than is attainable by any mechanical process? It is possible that the particles of charcoal are capable of being reduced to minuter dimensions than those of other insoluble substances, and that they are thus enabled to enter the pores of the veins. In connection with this subject, the absorption of metallic mercury by the skin, which has been already described, should not be forgotten. But in that case, the metal, in the form of an ointment, is forced by a mechanical process—friction—between the cells of the epidermis and the fibres of the true skin.

A few remarks concerning the hindrances to the absorption of medicines will not be here misplaced.

The thickness of the skin influences its absorbent power. This function is naturally most active where the cutis is most delicate, as on the inside of the thighs and arms, and the anterior surface of the trunk. When the integument is thickened by chronic disease, as ichthyosis, psoriasis, elephantiasis, &c., it absorbs imperfectly; and also when it has the doughy feel and sluggish vitality observed in persons of a marked lymphatic constitution. When a limb is paralyzed, its absorbent power is diminished; this is particularly noticeable when irritants, such as ammonia or cantharides, are applied to it. The presence of food in the stomach, or of dirt upon the skin, lessens the activity of these parts as absorbing organs; on this account, many poisons, taken when the stomach is full, produce comparatively slight symptoms; and hence also the precept to cleanse the skin thoroughly when the iatropic method is employed. As paralysis of a part impairs its absorb-

¹ Arch. Gén., 4ème sér., xx. 80.

² The Action of Medicines, p. 76.

³ Dub. Hosp. Gaz., and Am. Journ. of Med. Sci., July, 1858, p. 195.

ing power, so, too, does whatever temporarily draws away its vital activity to another part. When the brain is excited by thought, especially of a painful kind, the action of the stomach and bowels is impaired, digestion and defecation are suspended, and medicines administered by these organs operate imperfectly. The same statement is true in regard to certain affections of the brain and spinal marrow, of which obstinate constipation and a general insensibility to the impression of medicines are among the most prominent symptoms. That such large doses of opium can be borne in mania-a-potu, and in tetanus, is probably due, in part at least, to the fact that the medicine is not absorbed. In the former disease, an emetic or a purgative appears to increase the susceptibility to narcotics. If, instead of excessive irritation, the nervous system is oppressed by a mechanical pressure on the brain, or droops for want of a stimulant power in the blood, absorption is generally impaired, and medicines operate slowly and imperfectly. According to Casper, those parts which are most immediately dependent upon the brain are most affected in their absorbent power by its diseases, and he states that, in these diseases, the administration of medicines by the rectum is more efficient than that by the stomach. Dupuytren found that, in traumatic delirium, opium in clyster was more operative than opium by the mouth; and Casper says that the same is true in typhus. If he gave opium by the mouth, its effects were not perceptible for several days, but by the rectum it displayed its influence in a few hours. Or, if opium had been administered several times by the mouth, without perceptible effect, and an injection of laudanum was then administered, the resulting narcotic influence was apt to be excessive, because, meanwhile, the doses in the stomach had begun to act, the brain having been freed of its oppression through the influence of the dose administered by the rectum. In cholera, the vital powers of the digestive canal are so impaired, and the tendency to exhalation so completely neutralizes the absorbent function, that neither food nor medicine undergoes either digestion or absorption. A somewhat similar condition exists in the disease called lienteric, although in this case medicine appears to be more susceptible than food of being absorbed. At the two extremes of life, the function of absorption displays opposite degrees of activity; it is excessive in infancy, and deficient in old age. On this account, chiefly, the average doses of medicines for adults must be greatly diminished for children, and somewhat increased for the aged.

THE AVENUES BY WHICH MEDICINES ARE INTRODUCED, AND THE VARIOUS EFFECTS WHICH THEY PRODUCE.—It has already been shown

that almost every part of the body is capable of absorbing medicinal substances, but, as some tissues possess the power in a greater degree than others, or in practice may be more conveniently employed as absorbing surfaces, we shall next inquire what these are, and the peculiarities of their relations to medicinal substances. The veins, the mucous surface of the tongue, mouth, and lungs, the stomach, rectum, bladder, vagina, the eyes, ears, and nostrils, the skin and the cellular tissue, are the principal organs to which medicines have been applied. When brought into contact with the several organs, they are apt to undergo a change of composition or activity, in consequence of their chemical relations to the tissues or their secretions, and also to be more or less absorbed, in proportion to their solubility. The nervous associations of the organ chiefly acted upon will also determine, in some degree, the operation of the medicine.

Infusion, or the Injection of Medicines into the Veins.—This mode of applying medicines was used as early as the beginning of the 17th century. In the *Philosophical Transactions*, there is an account of the injection, by Dr. Fabritius, of two drachms of a laxative medicine into the median vein of the right arm of three patients in the hospital at Dantzick. In the comments on this narrative, it is said that “the dangerousness of this practice has justly brought it into disuse.”¹ In the *Boylston Prize Essay*, for 1821, the late Dr. Enoch Hale describes the effects produced in his own person by injecting half an ounce of castor oil into the median vein. In about half an hour, he perceived an oily taste in his mouth, with slight nausea, eructations, some commotion in the bowels, an “indescribable feeling which seemed very suddenly to ascend to his head,” with sudden stiffness of the jaws, and slight faintness. The abdominal disturbance, with pain, continued, but no evacuation took place, although there was a strong desire to go to stool.² But, although Scheel, Dieffenbach, Burdach, and others have also employed this method, the cases in which it is now recommended are comparatively few. They are these: when death, without prompt relief, is inevitable, and the ordinary means are useless; when foreign bodies become so wedged in the œsophagus as to obstruct its passage; in cases of asphyxia; insensibility from narcotic poisons or from alcohol; tetanus; hydrophobia; the collapse of cholera asphyxia, &c. In a certain number of cases of obstruction of the œsophagus by a foreign body, the injection of tartar emetic into the veins has provoked vomiting, which expelled the obstruction. In cholera, the blood becomes thick from the loss of serum, and saline solutions injected

¹ Phil. Trans., abridged, 1745, i. 23. ² Boylston Prize Dissertations, 1821, p. 117.

into the veins have, in some instances, restored its fluidity, but rarely, if ever, been the means of saving life. Liquids alone are suitable for this operation, and they should not be such as by their density tend to obstruct the bloodvessels, or, still more, such as have a chemical and coagulating action upon the blood. *Transfusion* of blood has been resorted to successfully in many cases. It is said to have been first used for the human species in 1666, by Kauffmann, at Frankfort on the Oder, to cure a case of obstinate lepra. In June of the following year, Denis, of Paris, used lamb's blood, by transfusion, for the relief of anemia and epilepsy, and in other cases besides;¹ and a few months later, Dr. Lower and Sir Edmund King employed the method successfully in England.² Soon after its introduction in France, a man expired while undergoing the operation, whereupon a decree was made forbidding its repetition, in any case, without the examination and approval of the Faculty of Paris. It appears to have been abandoned in other countries at the same time. Attention was drawn to the subject anew, in 1818, by Dr. Blundell, who invented an ingenious transfusion syringe, and performed numerous experiments, from which he concluded that the blood of one class of animals cannot be substituted in large quantities for that of another with impunity.³ In 1841, Mr. Peet showed that the operation was uniformly unsuccessful after respiration had ceased, and that the cases in which it is most useful are those of exhaustion by hemorrhage.⁴ In 1849, Dr. Routh collected 48 cases, 30 of which terminated in recovery.⁵ In 1852, Mr. Soden published an analysis of 36 cases of hemorrhage or exhaustion, connected with the puerperal state, in 29 of which this remedy had been used successfully.⁶ Of more recent cases the following may be referred to, one by Desgranges,⁷ seven by Mr. Higginson,⁸ and two by Mr. Wheatecroft.⁹ A special instrument for transfusion was invented by Blundell, improved by Routh, and still further improved by Mr. Higginson, its object being to keep the blood at a temperature which will prevent its coagulating, and to prevent any air from being injected into the vein. The quantity of blood injected has varied from one to twenty-four ounces, and, in the greater number of cases, from four to twelve ounces. The effects of the injection are represented to be those of a direct, powerful, and almost unfailing stimulus to exhausted

¹ ALBERS, *op. cit.*, p. 265.

² *Med. Chir. Trans.*, ix. 56.

³ *Med. Times*, Aug. 1849, p. 144.

⁴ *Bull. de Therap.*, xlii. 134.

⁵ *Liverpool Med.-Chir. Journ.*, Jan. 1857, p. 102.

⁶ *Lancet*, Oct. 1857, p. 354 and p. 443.

² *Phil. Trans.*, abridged, i. 22.

⁴ *Lancet*, Nov. 1841, p. 305.

⁶ *Med. Chir. Trans.*, xxxv. 413.

energy, even at the lowest point of vital existence, and when past the restorative aid of any other known means, either extraneous or inherent. In some cases of ultimate recovery, it caused delirious excitement, the pulse became frequent, and fuller, and more resisting, and where a venous murmur had previously existed, it ceased. Sometimes a state of exhaustion succeeds the excitement, where this has occurred, but does not appear to have been fatal. The least promising cases are those in which little or no reaction takes place. Transfusion has been successfully employed in collapse or exhaustion from hemorrhage; in exhaustion from protracted diseases, or those attended with discharges, or with organic lesions that impede nutrition. As before stated, it is only in the first that permanent advantage from the operation can be anticipated.

The Stomach.—The stomach is the organ best adapted by nature, and the one most usually employed for the introduction of medicines into the body. When empty, its absorbent power is most active, and it is especially so in the morning, before breakfast. But when the organ contains food, not only is the absorption of medicinal substances mixed with the food delayed, but they are apt to form new compounds with this latter. This is the case with metallic salts and oxides. Such of these as have a caustic operation, and in large doses act as irritant poisons, may exert but little influence when the stomach is filled with food. Owing to torpor of the stomach, produced by disease of the organ, general febrile disease, or imperfect excitability of the nervous centres, or, on the other hand, in consequence of a morbid susceptibility of the stomach itself, medicines may be either slowly and imperfectly absorbed, or rejected by vomiting. In the former class of cases, it is necessary either to combine stimulants with them, to make stimulant applications to the epigastrium, or to administer stimulant enemata; and in the latter cases to associate the medicine with opiates or sedatives, or by means of a revulsive action on the epigastrium, or the endermic application of a salt of morphia, or by some equivalent measure, to reduce the susceptibility of the stomach to a proper point.

Liquid medicines act most promptly, as a general rule, when given by the stomach. Water and alcohol are entirely absorbed by this organ, and with them many substances which they are used to hold in solution. The more complete and the more diluted this latter is, the more rapidly is the liquid absorbed. Hence natural saline mineral waters are much more active than is the quantity of solid ingredients they contain, when it is given in artificial solution. The absorption of solid medicines depends almost altogether upon their degree of

solubility in the gastro-intestinal secretions. Mineral substances, insoluble in water, are often made extremely soluble by means of the gastric acids. This is eminently the case with iron, mercury, magnesia, &c. Other medicines, which are unaffected by organic acids, dissolve under the influence of the alkaline secretions of the pancreas and liver. Sulphur and iodine are said to belong to this category, and all fixed oils and fatty substances are emulsified by these secretions before being absorbed by the lacteals. The same alkaline menstruum dissolves resinous substances, such as catechu, kino, benzoin, copaiba, guaiacum, &c., and many other active principles, *e. g.* creasote, cantharidin, piperin, elaterin, capsicin, &c. Volatile oils are said to become oxidized and converted into resins by the gastric juice, and thus to become soluble in water. Thus turpentine changes into common resin (which consists of two isomeric acids, pinic and sylvic), and is then dissolved by the pancreatic juice. Vegetable substances soluble in water, as sugar, vegetable acids, the natural salts of the vegetable alkaloids, and neutral soluble principles not partaking of the nature of alkaloids, such as emetin, caffèin, salicin, and the soluble active principles of senna, aloes, and gentian, with atropia, daturia, hyoscyamia, conia, and nicotia, are all absorbed with facility. Among other soluble products of the vegetable kingdom may be enumerated alcoholic and ethereal fluids.¹

On account of the sympathetic connection of the stomach with the rest of the system, this organ is often selected for awakening salutary actions in the whole economy by an impression made upon itself. This is particularly the case when emetics are administered for the purpose of exciting perspiration, promoting secretion, relieving the head of congestion, the air passages of obstructions, &c. It is also to be noticed that most of the individual peculiarities in regard to the action of medicines relate to such as are developed when they are administered by the stomach. In it, and in the intestinal canal, are generally contained those accumulations of vitiated secretions which frequently become the original cause of disease, or which assist in maintaining it, and which must modify the operation of medicines.

The Rectum.—The secretions of the rectum, unlike those of the stomach, are generally alkaline, and consequently many medicines which are readily absorbed after undergoing decomposition by the gastric acids, are not adapted to affect the system when administered by the rectum. Such is the case with acetate of lead, the greater part of which, when given by injection, exerts only a local action. Still

¹ HEADLAND, the Action of Medicines, p. 61, &c.

more strikingly is this the case with food, and hence the impossibility of sustaining life by means of nutritious enemata. Other substances which are susceptible of absorption without change, may exert their peculiar influence through this channel. Bulky medicines, and those of an irritating or stimulating quality, are not adapted for this mode of administration, because they are apt to be speedily rejected, and also, because the absorbing surface of the rectum, even if it were equally active with that of the stomach, is more limited in extent. Moreover, the sympathetic relations of the former organ are vastly inferior to those of the latter. In regard to the capacity of the rectum for the absorption of nutriment, there are probably cases in which this function, however limited, may be made of great service; as where, from the refusal of a patient to swallow food, extreme irritability of the stomach, or other incapacity of this organ of a temporary nature, life may be prolonged until the return of a more natural state of things permits the administration of food by the mouth. Cases of the sort are related by Mr. Henry Smith, of London.¹

It is generally believed that the absorption of medicines by the rectum is much less active than by the mouth, and consequently, that the dose should be greater by the former than the latter. Richter and Pereira say that it should be five times, and Trousseau, Albers, and Dr. Wood, that it should be two or three times greater. On the other hand, Orfila and Dupuy, and, following them, Merat and Delens, Bouchardat, and other French therapists, assert that the dose by the rectum, and especially of narcotics and medicines soluble in water, should be less than that administered by the mouth. Spillan places narcotics under the latter rule, but acrid substances under the former. Others, again, will have it that the dose should be the same in both cases. In regard to alcoholic tinctures of narcotic substances, we believe that at least a double dose by the rectum is required to produce the effect of an ordinary dose by the mouth. If, however, the dose by the mouth have been gradually increased under the influence of habit, twice this quantity by the rectum could not be safely administered, for it seems probable that the diminished susceptibility of the stomach to the medicine is the consequence of a local action from which the rectum has remained exempt. The comparative absorbent powers of the two organs in question have not been sufficiently tested, but there is reason to think that they are not the same for all medicines. For example, M. Briquet states that sulphate of quinia, given by enema, has the same effect by the rectum as by the mouth, pro-

¹ Med. Times and Gaz., June 1853, p. 626.

vided the dose do not exceed fifteen grains.¹ On the other hand, Restelli affirms of the salts of strychnia and morphia dissolved in alcohol, that in animals these substances are more speedily poisonous, and in smaller doses, when thrown into the bowel than into the stomach.² These discordant facts and opinions should suggest a cautious use of powerful medicines by means of enemata.

Medicines are also administered by the rectum when an obstruction to swallowing exists in the mouth or œsophagus, when the stomach is irritable, or when the disease occupies the large intestine, bladder, uterus or other pelvic organs. Stimulant enemata, as of spirits of turpentine, are often used for their direct operation as well as for their derivative action upon the brain. Suppositories are frequently introduced into the rectum containing narcotic or astringent substances, intended to act upon that bowel or the adjacent parts; and occasionally vapors such as tobacco smoke, carbonic acid gas, and the vapor of chloroform or ether, are injected to overcome spasm, or to relieve pain. Whenever this method is resorted to, the rectum should first be thoroughly cleansed by means of enemata of tepid water.

The Mouth and Fauces.—To these and the adjacent parts, medicines are seldom applied, except for the relief of local disorders, such as neuralgic or inflammatory toothache, ulcers, aphthæ, false membranes, suppuration of the nasal passages, of the tonsils, pharynx, Eustachian tube, &c. Sternutatories are applied to the nostrils, and various stimulants intended to rouse the brain in cases of syncope; masticatories are used to excite the secretion of the salivary and other glands supplying the buccal cavity. The mucous membrane of this part has been made use of for introducing mercury, and also gold, by friction, but without evident reason or approved advantage.

The Skin.—Medicines are applied to the skin, both when the cuticle is sound, and also when it has been removed by vesication, in order to make a revulsive impression, to produce a local alteration, or to affect the economy by their absorption.

It was anciently the custom to anoint the skin with medicated oil, and to apply various anodyne and discutient plasters to affected parts. Theophrastus relates that strong scented cataplasms applied to the stomach impart their odor to the eructations. More recently the treatment of syphilis by mercurial inunctions, and the long known fact that blisters of cantharides produce strangury, although they were most striking illustrations of absorption, do not appear to have suggested the existence of this function until after the discovery of

¹ Bull. de l'Acad. de Méd., xxii. 257.

² Annuaire de Thérap., 1848, p. 223.

the lymphatics. Some of the earliest proofs of cuticular absorption were furnished by physicians of Philadelphia. The experiments and arguments of Dr. Mussey, of Drs. Coxe, Joseph Klapp, H. Rousseau, and S. B. Smith, of this city, and those of Dr. J. B. Stuart, of Albany, went far to establish the fundamental facts on which this doctrine rests.¹ They showed that certain coloring and odorous matters applied to the skin affected the breath or the urine. Attempts to elucidate this subject were resumed at a later period. Dr. Dill, of Edinburgh, showed that in a warm bath (86° to 102° F.), the body generally, but not uniformly, increases in weight.² This trial does not always result in the same manner, as Dr. Dill's own experiments, and those of Dr. James Murray, with baths at a temperature between 88° and 104° F., clearly show.³ The latter gentleman proved, by tests applied to the urine, that gallic acid is absorbed by a person immersed in a bath containing infusion of galls. Prussiate of potassa was found, by Westrumb, in the blood and urine of persons who had used foot-baths containing this salt, and the urine, as well as the serum of the blood, was colored brown when the arms were kept immersed in an infusion of rhubarb.⁴

The more recent experiments of Duriau, while they tend to reconcile some of the contradictory results above referred to, throw doubt upon the power of the epidermis to transmit several medicinal substances usually supposed to have a peculiar facility of penetration.⁵ By these experiments, it is rendered clear that for every person there is a temperature at which the body immersed in water neither gains nor loses in weight; while, on the one hand, above this point it exhales more than it absorbs, and, therefore, becomes lighter, and, on the other hand, below this point it absorbs more than it exhales, and grows heavier. Thus, in a bath of from 72° to 77° F., the skin *absorbs*, on an average, 248 grains in a quarter of an hour, 442 grains in three-quarters of an hour, and nearly 700 grains in an hour and a quarter. On the other hand, in baths at an average temperature of 97° F., the body *loses* in weight at the rate of 744 grains in 15 minutes, 1271 grains in 30 minutes, and 2054 grains in 45 minutes. In a bath of 113° F., the body lost more than a pound in weight in the course of fifteen minutes. By this simple statement it becomes evident that, even in the case of water, exhalation is a more active function of the skin by far than absorption.

¹ Med. Museum, i. 14, 34; vi. 55, 209, 227.

² Trans. Med. Soc. Edinb., ii. 363 (1826).

³ The Influence of Heat and Humidity, Lond., 1829, p. 141.

⁴ Jour. des Progrès, 1828, xi. 13.

⁵ Archives Gén., Fev. 1856, p. 161.

M. Duriau attempts to prove that the epidermis imbibes liquids of a proper density, in virtue of a purely physieal property, but that it does not very readily permit them to traverse it. This is shown by its retaining so perfectly the serum of blisters, and bullæ, and vesicles. Whatever liquids are absorbed by the true skin must first reach it through the epidermis by imbibition. In M. Duriau's experiments with prolonged baths containing iodide, carbonate, nitrate, or prussiate of potassa, eommon salt, sulphate of magnesia, or alum, and at a temperature varying from 86° to 93° F., none of these substanees could be detected in the urine. In this result there is nothing surprising, for the temperature of the baths used was considerably higher than that which is assigned above as the most favorable to eutaneous absorption, viz., 72° to 77° F. The experiments have, therefore, no real bearing upon the question of medieinal absorption. It is, however, an interesting, and probably an important fact, that in every ease the urine became alkaline during the use of the bath; and that this ehange did not depend alone, if at all, upon the absorption of any saline base, was proved by the same effect ensuing when nitric acid or sulphate of quinia was dissolved in the bath instead of an alkaline salt.

In the above experiments, it will also be observed that the substances employed were exclusively saline, and they do not, therefore, impugn the earlier observations, that coloring, odorous, and other vegetable principles and animal substances may enter the economy by eutaneous absorption. All those which it has before been said operate by penetration prove this to be true. Cantharides, mustard, ammonia, ehloroform, ether, mezereon, turpentine, narcotic extracts, and many other substances penetrate the epidermis, and act upon the ehorion, and if they are not then absorbed into the eirculation it is not because the epidermis forms a barrier to their admission. But we have no doubt that they are absorbed, and salines as well as coloring and other principles. The error in M. Duriau's experiments has already been alluded to: his eonclusion in regard to saline substances is contradicted by other and trustworthy experiments, which are supposed, moreover, to show that the lymphatics are more active than the veins in absorbing them. This is attributed to the fact that upon the surface of the skin the former vessels are more abundant than the latter, and more easily penetrable. The effects of superfieial abrasions and poisoned wounds, of blisters, &c., which eonsist primarily of inflammations of the lymphatic trunks and glands, render this opinion probable.

But although mere contact is sufficient to induce the absorption of medicines by the skin, this function is rendered much more active when

they are mechanically forced through the epidermis by friction. It must be remembered that the outer layers of this membrane consist of dry and flattened cells or scales, between which the operation referred to forces the medicinal substance, and brings it immediately in contact with the actively absorbing tissue which lies beneath. In this manner, only, can be explained the actual disappearance of unctuous and liquid medicines applied by friction to the skin, and the discovery of mercury in the deeper layers of the skin, and in the peritoneal cavity, after it has been rubbed into the integuments. It is worthy of remark that the metal, if oxydized in the ointment, becomes deoxydized during its transit. This mode of application was systematized by Chrestien,¹ under the name of the *iatroliptic* method (ἰατρειὸν, I cure, ἀλειψω, I anoint), and employed by him in a great variety of affections, and with very many medicines. Fat, oil, and alcoholic liquids are used as vehicles for these latter; soap liniment is one of the best, and the friction should be made steadily for five, ten, or even twenty minutes, and until all of the substance employed has disappeared. Mercury is the medicine most frequently applied in this manner, but iodine, camphor, and various narcotics are occasionally used. As it is not only by vital absorption, but also by penetration, that the medicines thus applied become efficient, the required frictions should be made as near as possible to the affected part, and with such gentleness as to avoid bruising it. Or, if it is intended to affect the whole system by causing the absorption of the medicine, a part should be selected where the skin is delicate, smooth, and free from hair. Such are the inner side of the arms and thighs, the sides of the neck and chest, and the groins. The state of the part influences, in some degree, the action of medicines applied to it. This is generally greatest when the skin has been thoroughly cleansed, and also softened by warm and moist applications, and the liquid or substance employed is also of a suitable temperature. An inflamed skin absorbs but little. Besides the frictions now described, medicines are often used to act upon the skin by mere contact. Baths, both general and local, lotions, fomentations, and poultices, which in their simplest forms are merely vehicles of heat and moisture, are often also medicated, that is to say, contain substances which act as stimulants, sedatives, or anodynes. Of these may be mentioned, as examples, sinapisms, poultices containing various herbs yielding essential oils (labiatae), narcotic extracts, lead water, &c.; ointments and lotions holding irritants in solution, such as cantharides, croton oil, tartar emetic, &c. It is true that the greater

¹ De la Méthode Iatroliptice, Montpellier, An. xii.

number of these agents are only local in their operation, yet they owe their virtues either to their absorption, or to their penetration.

Medicines are also applied to the derm denuded of its cuticle. This is known as the *endermic method*. Although it had been employed experimentally upon animals by Orfila and Magendie, and by Bally, at St. Domingo, who applied calomel to the denuded derm of the epigastrium in yellow fever, it was first proposed as a systematic plan of treatment by Lemberet and Lesieur, at Paris, in 1824.¹ Various observers soon confirmed the statements originally made respecting the efficiency of the new method, among whom may be mentioned Martin, in France,² and Dr. Gerhard, of Philadelphia.³ The following conclusions of Dr. G., based upon observations made in nearly two hundred cases, may be regarded as substantially correct.

"Medicines applied to various parts of the body externally, provided they be placed in direct contact with the vascular surface of the cutis, produce similar effects in doses but little larger than when they are made to act directly upon the gastric mucous membrane.

"All medicinal substances have a peculiar affinity for certain organs or tissues, which is entirely independent of their immediate action upon such parts.

"Violent irritants or escharotics rarely produce any general effect, although this sometimes occurs.

"All other articles of sufficient activity may be used, provided the cutis be not too highly inflamed; when the latter is the case, soothing applications are, in the first place, necessary, or no absorption will take place."

Dr. Gerhard found that sulphate of quinia, the salts of morphia, and other preparations of opium, belladonna, cicuta, stramonium, and digitalis; aloes and gamboge; squill, emetin, and oil of tobacco; mercury and iodine were readily absorbable in this way, and produced all their specific effects; but the action of rhubarb, jalap, elaterium, croton oil, extract of colocynth, and tartar emetic, was slight or imperceptible. Ahrensen⁴ and many others have, in the main, confirmed these results.

Numerous circumstances render the endermic method a precious resource for the therapist. An inflamed or irritable state of the stomach or bowels sometimes renders it difficult or even impossible to employ these organs for the administration of medicines. Hæmorrhoids may thus disable the rectum, or chronic ulceration or acute

¹ Archives Gén., v. 158.

² Revue Méd., Sept. 1827.

³ N. Am. Med. and Surg. Journ., ix. 392; x. 145 (1830).

⁴ Lond. Med. Gaz., xxiv. 699.

inflammation, the stomach. The last case is a familiar one in malarial fevers. Or a mechanical obstruction, temporary or permanent, spasmodic or material, may prevent swallowing, as in tetanus, spasm of the œsophagus, cancer of this tube, or a foreign body impacted in it. Or the stomach, and also the rectum, may have lost their sensibility, as it is called, to the action of certain medicines. Their power of absorption may be impaired or lost, and yet the susceptibility of the nervous system to narcotics applied endermically may be fully retained. In other cases the patient will not swallow a medicine on account of its offensive taste, or it must be given without his knowledge.

An illustration of the value of this method is furnished by the following example. Salgues reports four cases of constipation in which all medicines given by the mouth were vomited, and those administered by the rectum were unavailing. But the application of finely powdered colocynth or aloes to the blistered skin, produced copious evacuations.¹

As the part to which the medicinal substances are here applied is small in extent, and does not, like the stomach, secrete liquids capable of dissolving them, they should contain but little inert matter, and, indeed, if possible, be susceptible of complete absorption. On this account, the salts of the vegetable alkaloids are to be preferred, viz., of strychnia, morphia, conia, aconitia, atropia, quinia, &c. Next to these, in fitness, are the narcotic extracts. But powerful chemical irritants, and substances which are insoluble in the secretions of the derm, are unsuited to the purpose.

Liquids are not adapted to endermic application because they cannot be kept in contact with the part. Even if applied on compresses, these latter imbibe too large a proportion of them. Oily and fatty substances are sometimes used as vehicles, but besides diluting the medicine unduly, they are a direct hindrance to its absorption in most cases. If not of too irritating a nature, the medicine should be applied in powder; but, in the opposite case, a very small quantity of mild ointment may be used, or what is still better, a neutral powder, such as starch, will serve to mitigate the severity of the application. However applied, the medicine should be immediately covered with a piece of soft rag or lint spread with simple ointment.

The requisite vesication may be produced by various escharotics, by mineral acids, by an iron instrument dipped in boiling water, by caustic ammonia, or by cantharides. Of all these, the last is to be

¹ Abeille Med., ii. 30.

preferred, for it does not involve the cutis so deeply, nor leave a scar, as do the acids and the hot iron, nor is it so painful as ammonia. When the medicine is to be used in a concentrated form, a blister not more than an inch or two in diameter should be applied for two or three hours, after which, under a poultice or a dressing of simple ointment, the necessary vesication will be produced. It is better not to remove the cuticle at the first dressing, but to insert the medicine by raising an edge of the detached membrane. On each renewal of the dressing, the part should be cleansed with warm water, or soap and water.

It is difficult to determine precisely the relative doses of medicine to be used by the endermic method. Two or three times the average dose by the mouth, is that which is generally prescribed on a first trial.

The epigastrium is the part most usually selected for the endermic application of medicines; but the arms or thighs may be used if more convenient, or in alternation with the part first mentioned. In painful disorders, a portion of the skin nearest the part affected is generally to be preferred.

Another method of introducing medicines through the skin, is *inoculation*. It was first suggested by Lafargue, in a memoir presented to the Academy of Medicine, in 1836. He made use of morphia, strychnia, belladonna, and quinia, and seemed to attach more importance to the form and dimensions of the pustules produced, than to the action of the medicines upon the economy, which, indeed, according to a report of Martin Solon upon the paper of Lafargue, appears to have been very slight indeed.¹ In a later article, by the last named writer, fifteen or twenty punctures are said to have been necessary to obtain the narcotic effect of morphia. He appears, however, to have been successful in relieving many local pains of a neuralgic and rheumatic character. Besides the substances above mentioned, he also inoculated veratria, tartar emetic, and croton oil.² But this method was subsequently rendered vastly more efficient by Langenbeck, who showed that as the mechanism for cutaneous absorption lies *under* the cutis and not in it, the most marked effects were to be expected only when medicinal substances are introduced quite through the true skin.³ Indeed, the effects are incomparably greater. Often, says the author named, have I seen iodine employed after this manner produce a more decided effect than three times the quantity applied endermically.

¹ Bull. de l'Acad., i. 13, 40, 249.

² Bull. de Thérap., xxxiii. 19, 182, 349.

³ Die Impfung der Arzneikörper. Hannover, 1856.

Medicines also exercise a more protracted influence than when used in any other manner. Four grains of the extract of hyoseyamus, for instance, inoculated in the skin of the temple produced headache, giddiness, redness of the face, dilatation of the pupils, transitory disturbance of the mind, burning in the throat and intense thirst, which continued for the space of three days.

It appears that a certain amount of irritation is requisite to cause the most perfect absorption of the substance employed, and Langenbeck uses such formulæ as the following: R.—Ung. antim. tart. ℞ss, Ext. belladonn. gr. vj, Ol. amygdal. ℞j. M. Or, R.—Ol. tigllii gtt. iv, Hydr. bichlorid. gr. iv, Ung. terebinth. ℞ss, Ol. amygdal. gtt. viij. M. It is also desirable that the substance should be as soluble as possible, consistently with the introduction of it in sufficient quantity.

The singular statement is also made that the phenomena produced by inoculated medicines, are in some cases different from those occasioned by their internal administration. Thus musk is powerfully anodyne, and croton oil does not produce diarrhœa. Hence it is probable that some medicines taken internally, owe the peculiarity of their action to a decomposition in the primæ viæ, and others chiefly to a local operation upon these latter, whereby their absorption is prevented or limited. So several animal poisons which are active, and even fatal, when introduced into the blood, may be taken into the stomach with impunity, as, *e. g.*, the venom of serpents, the poison of rabies, &c.

The degree of local irritation produced by inoculated medicines depends, in some degree, upon the susceptibility of the patient, and of the part to which they are applied. It is not always such as might be expected from the qualities of the substance used. Croton oil and tartar emetic are generally well borne, and for a few hours, at most, give rise to burning, smarting, or a sense of tension. In most cases they are less painful than sinapisms or blisters, a circumstance which may be explained by the consideration that these latter are applied to the sensitive and highly vascular chorion, but the former to the cellular tissues beneath the skin. If, however, the quantity of the medicine introduced be excessive, active local disturbance may ensue.

The phenomena produced by this operation are usually the following: The skin is more or less reddened according to the quantity of the medicine employed. It swells, grows red and more or less hard, as its own and the subcutaneous tissue are more or less dense. The puncture remains open, and a small discharge of serum or pus may follow upon pressure. If several punctures are made too close together, they may ulcerate, and form a single opening followed by an

ulcer. In adults, a single puncture into which the medicated lancet has been several times thrust, may remain open for eight or ten days.

Medicines are inoculated, as the matter is introduced in vaccination. The instrument consists of a small lancet with an elongated diamond shaped head, very sharp at the point, and on the edges, and somewhat bent, as well as concave, upon one of its faces, for the purpose of holding the medicinal substance. The lance-head is connected by means of a round and narrow stem with a convenient handle, and is itself one or two lines in breadth, though sometimes, and for special operations, a breadth of four or five lines is required. The inoculation is performed by thrusting the instrument, charged with the medicine, obliquely through the skin, and pressing in the direction of the back of the instrument until the integument is entirely penetrated, so as to prevent a loss of the medicinal substance. On withdrawing it, however, pressure is to be made in the opposite direction, and a finger laid upon the skin in front of the lancet, so as to empty this latter completely. If the hemorrhage is considerable, it should be allowed to subside before inserting the needle anew. For this purpose, one made of ivory or horn is to be preferred. Medicinal substances may also be introduced beneath the skin upon a small piece of linen lint, through an opening made with a lancet.

In this manner, mainly, all medicines which are operative in small doses have been used; the alkaloids, narcotic extracts, opium, musk, camphor, creasote, essential and certain fixed oils, various salts, &c.

Inhalation.—From the time at least of Dioscorides and Galen, the inhalation of medicated vapors has been more or less employed in various diseases, and especially in those of the lungs. In the East the fumes of opium have been used from time immemorial, to produce intoxication. In 1580, Piso recommended hot dry air for the cure of consumption. In 1654, Bennet, a London physician, caused the patient to breathe the atmosphere of a chamber filled with fumes or vapors of various medicinal substances, including the gum resins. Bartolinus prescribed the vapors of pectoral and healing plants. Willis advised the fumes of various balsamic substances and of orpiment, and Mead the former of these medicines. In 1769, Buchoz employed the vapors of a decoction of several herbs, and about the same time, Billard adopted the method of dry inhalation, after the manner of Bennet.¹ In later days we find that after the discovery of the elementary gases in the last century, this mode of treatment was revived, and Beddoes extolled it as a panacea for nearly all chronic ailments. With the

¹ KNEELAND, Boston Med. and Surg. Jour., lviii. 49.

demonstration that medicines act chiefly by being absorbed, and that the lungs are very active in the absorption of gases and vapors, the idea naturally presented itself of making use of these organs for the purpose of applying medicines in their own diseases, as well as in those of the whole system. So Davy, in 1814, recommended nitrous oxide gas, and Crichton, in 1823, introduced anew the inhalation of the vapor of boiling tar, in pulmonary affections. For the same diseases, the vapor of iodine was recommended by Sir James Murray and Sir C. Scudamore. The addition of a little tincture of conium was found beneficial in subduing the irritating qualities of the gas. In France and Germany chlorine gas was used somewhat later, as an inhalation for the cure of phthisis. Belladonna and stramonium were smoked for the relief of spasmodic asthma and various pulmonary complaints, as first recommended by Martin Solon. M. Trousseau revived the ancient practice of inhaling arsenical vapors in chronic bronchial affections. Naphtha had been proposed by Crichton in 1816, in these diseases; the same remedy was vulgarized by Hastings, and tar vapors were held to be as sovereign a remedy as tar water had been a half century before. Skoda eulogized them in gangrene of the lung, and Raspail invented his camphorated cigars for the solace of innumerable ills. Harwood published, in 1839, an elaborate essay on the advantages of inhalation in pulmonary affections, in which he speaks of all the substances hitherto used for the purpose, and, among them, of sulphuric ether, of which he remarks that, "in inhalation, its sedative or anti-spasmodic influence appears liable to be overwhelmed by its stimulant properties."¹ The discovery of the anæsthetic effects of the inhalation of sulphuric ether in 1847, and soon after of the similar operation of chloroform, gave a new impulse to this branch of the healing art. The inhalation of iodic vapors was revived by Piorry and by Chartroule, and the two liquids just mentioned were employed as vehicles for conveying a great variety of substances into the system through the lungs. The vapors of ammonia and of sal ammoniac were declared by Giesler and Laségue, to effect very remarkable changes in phthisical cases.² In 1851, the late Dr. Snow proposed an apparatus for the inhalation of dry and moist vapors, so arranged as to insure their disengagement from the substance supplying them and their complete reception by the patient.³ A somewhat similar but more elegant apparatus has more recently been used by Mandl, who says, very correctly, that of all the methods of treating that rebellious

¹ On the Practical Use of Inhalations, in Diseases of the Throat and Chest. Lond., 1839.

² Archives Gén., 5ème sér., vii. 721.

³ Lond. Jour. of Med., iii. 122.

form of chronic bronchitis which follows chronic pleurisy, this is the most successful.¹ Except for the purpose of allaying cough, applying stimulants to the bronchial mucous membrane, and introducing anæsthetic vapors as rapidly as possible into the system, this method is seldom employed. As the above retrospect of its history shows, it has by turns been vaunted and neglected, and it is now most generally found in use by practitioners who inhabit the debatable region between medicine and quackery.

Of late pulverulent and also liquid substances have been introduced into the air passages. Originally proposed and practised by MM. Trousseau and Belloc, and Sir Charles Bell, this method has since been applied in a great variety of cases, and with numerous medicines, by Dr. Green, of New York, and by E. Watson, S. S. Alison, DeMussy, and others in Europe. Its utility is chiefly displayed in the treatment of chronic inflammations of the larynx.

The skin and mucous membrane serving as integuments to the organs of several of the senses, the *eyes*, *ears*, and *nose*, are also used for the application of medicines which are designed to exert a local action chiefly, though occasionally, as when certain irritants (sternutatories), are applied to the nasal passages, a derivative operation from the head or eyes is intended. Medicinal substances are also introduced into the *vagina*, but generally to relieve pain or modify the action of its walls or of the uterus. A similar remark applies to the *urethra* and the *bladder*.

From the account which has now been given, it will appear evident that every portion of the body in which organic changes are going on, is susceptible of absorbing some medicinal substances, but that the gastro-intestinal mucous membrane is that which, on the whole, is most convenient in practice, and through which the most certain effects may be obtained. Next to this, the denuded derm and subcutaneous cellular tissue present the greatest advantages, after which, in order of importance, are the pulmonary mucous membrane and the veins.

THE CHANGES WHICH MEDICINES UNDERGO AFTER ABSORPTION.—It has been stated that the greater number of medicines undergo changes in the stomach and bowels, affecting their solubility and the facility of their absorption, and that these changes depend upon their chemical reaction with the pepsin or the acid of the stomach, or with the alkaline secretions of the pancreas and the liver. The changes in question may be, according to Mr. Headland, *combination*, *reconstruction*, or *decomposition*. When acids or alkalies are taken, they are

¹ Bull. de Thérap., liii. 433.

neutralized soon after absorption, and converted into salts. This, as Mr. H. remarks, does not destroy their influence; for in being neutralized they diminish, in the blood and in the system generally, the quantity of basic or of acid matter, and thus tend to alter the reaction of the secretions. Although an acid may combine in the blood with soda, or with salts of soda, yet by so doing it creates an excess of some other, and probably an animal acid, which, being set free, acts on the secretion of urine much in the same way that the first acid would have done. But it is maintained that when salts, oxides, &c., are taken into the blood, they do not really yield to surrounding chemical affinities, as they do out of the body. Did they do so, many of our most valuable medicines would be decomposed and rendered insoluble there. All the mineral salts would be precipitated by the free soda in the fluid. Acetate of lead would be immediately decomposed by the sulphates, and nitrate of silver precipitated by the chlorides. It is probable that the vital forces, as well as the viscidities of the plasma, exert a retarding or controlling power over such chemical tendencies. Some substances are decomposed while passing out of the body. Thus the contents of the intestines cause the formation of sulphuret of iron, when chalybeates are taken, which blackens the fæces; and the saliva forms a sulphuret of lead along the edges of the gums, when lead is administered for some time. So Bernard found that when a solution of prussiate of potassa and one of lactate of iron were injected simultaneously into the opposite jugular veins of a rabbit, the urine of the animal was rendered deeply blue, while no trace of a similar color existed in any of the organs.¹ On the other hand, certain substances introduced separately into the blood may there unite and produce effects of which neither by itself is capable. This, as Bernard has shown, is the case with amygdalin and emulsin. By their union in water, prussic acid is generated, and hence, if injected separately into the blood, the peculiar effects of this poison are developed. The same result takes place if amygdalin is introduced into the digestive tube, and the emulsin into the blood; but not if the counter-experiment is tried, for in the former case the amygdalin is absorbed, but in the latter the emulsin does not undergo absorption.²

In other cases the elements of the substance employed are *reconstructed*. Thus, when tannic acid is administered, gallic acid is secreted with the urine. Benzoic and cinnamic acids are converted into hippuric acid, which also passes out with the urine. Turpentine changes into a volatile oil, which communicates to the urine an odor of violets.

¹ Archives Gén., 4ème sér., xvi. 63.

² Lond. Med. Gaz., Nov. 1850, p. 908.

Again, the medicinal substance may be *decomposed*, and, under a new arrangement of its elements, its action may be neutralized or reversed. The alkaline bases of vegetable salts, for example, are changed in the blood into alkaline carbonates, and affect the urine in the same way as free alkalies.

In the existing state of knowledge concerning these relations of medicines to the economy, it would be unwise to adopt them implicitly as guides in practice. At the same time they should not be overlooked when they serve to explain results which have been reached empirically.

OF THE CURATIVE ACTION OF MEDICINES.

Having now considered the manner in which medicines, as material agents, operate upon the animal economy, and particularly the mechanism by which they enter the system and are conveyed from place to place, and also, some of the changes which they work in the fluids, we may briefly inquire respecting the mode in which they exercise their *curative* action, or by what modifications of substance or function they effect this object.

The operation of a medicine depends upon numerous circumstances. First, and evidently, it depends upon its own inherent and essential qualities. Opium soothes pain, and croton oil purges, and ipecacuanha vomits, because it is their nature so to do. Further, the degree of this operation depends upon the dose of the medicine administered, and is, within certain limits, proportioned to it. The solid or liquid state of the medicine, the condition of the organ, or of the person on which it acts, &c., will still further modify its action. In almost every case, medicines produce either upon the part to which they are applied, or upon the system generally, an impression which is called their *action*. This is either *essential* or *contingent*. The former is that which the medicine exerts under ordinary circumstances, as an astringent, demulcent, emetic, purgative, or tonic action. The latter depends upon the conditions of the individual case, as when an emetic also acts as a purgative or a diaphoretic, or when copaiba, besides modifying the urine, occasions an eruption of urticaria. In another sense, the removal of a disease may be called a contingent effect of medicines, but generally this is a remote consequence of their essential action, and is called the *therapeutic operation*. When medicines are administered to the sick, it is difficult, and often impossible, to distinguish between certain effects produced directly by the remedy, and

those which result from the spontaneous subsidence of the disease. Thus, during a fever, if diaphoresis occurs upon the decline of the paroxysm, we are apt to attribute directly to the remedy employed what was really due to the natural solution of the attack. This distinction is nevertheless important; as, for example, when opening of the bowels follows the administration of opium in colica pictonum. The nature of opium is to constipate, and, in this case it only operates otherwise, by inducing relaxation of the contracted muscular coat of the bowels. This example shows that the physiological action may become subordinated to the therapeutical action of a medicine, or, if it be preferred, that a relatively stronger therapeutical action (the anti-spasmodic) may in this case outweigh the weaker (the constipating). In many cures, however, there is no evident distinction between the two operations, either because the medicine is administered in such doses as do not disturb the physiological action of the system, or because, by the very nature of the medicine itself, it cures the disease without deranging the functions. Mercury, as an antiphlogistic and as an anti-syphilitic remedy, illustrates both of these conditions.

There is also a *primary* and a *secondary* operation of medicines. Sometimes the one and sometimes the other is curative. All medicinal stimulants are useful by their primary operation alone, and, indeed, the depression which ensues tends to impair the advantages of the original impression. Primary sedatives seldom exert a secondary stimulant operation; indeed, cold is the only one that has this effect, and not then, unless it is applied in a certain degree. The terms in question are, however, frequently used to indicate a difference in the kind as well as in the degree of action. Vegetable tonics, for example, act as stimulants to the stomach, and this is their primary action; but as a consequence of it, the function of digestion is more thoroughly performed, and the nutrition of the body is improved. The latter constitutes the secondary operation. Purgatives and emetics irritate the bowels and occasion diarrhœa or vomiting; this is their primary operation, but they may at the same time relieve congestion of the brain or lungs, and thus exert a secondary and curative influence. In these cases the secondary operation is also called *indirect*, as opposed to the *direct*, which might here be substituted for the former, by means of cups, leeches, or blisters, applied to the head or chest. The sympathetic relations established between two organs which are not anatomically connected, except through the nervous and vascular systems, enable us, in many cases, to make use of an indirect medication. Thus, suction of the mamma will sometimes induce a premature action of the gravid uterus; in metastasis of the mumps from the parotid

gland to the testis, warm or stimulant applications will often recall the affection to its original seat. Similar illustrations abound in the history of gout and rheumatism.

The *specific* operation of medicines requires more particular examination. By a specific medicine, says Boyle, "I do not understand one that will cure a disease infallibly and universally; for, I confess, I never yet met with any such remedy. Nor do I, by a specific medicine, mean one that, like a charm, works only by some latent and unaccountable property, without the assistance of a known quality. But by specific, I here denote a medicine that most commonly, and better than ordinary means, gives considerable relief to the patient by acting principally upon the account of some peculiar virtue; so that if it have any benign manifest quality, yet the service it does is greater than can reasonably be ascribed to such a degree of the manifest quality it possesses."¹ Modern investigations have not discovered that sort of specific which Boyle never met with, but there are several which do exert a curative virtue "without the assistance of a known quality" to explain their cures. These are mercury, cinchona, iodine, and colchicum, which in syphilis, ague, goitre, and gout, respectively, are capable of curing without the intervention of any evident modification either of function or of structure. But as these effects are not absolute, as there are many cases of every disease mentioned which is rebellious to the corresponding remedy, we are forced to suspect that even these medicines are not specifics in the sense of Boyle's second definition. At the same time, as we are wholly and absolutely ignorant of their mode of cure, and almost or quite as ignorant of the nature of the diseases to which they are antidotes, it is not impossible that in the progress of discovery the now unknown elements may be disclosed, and that we shall find these medicines illustrating some of the laws under which remedies in general operate. The third definition of Boyle is one which cannot be accepted unless it be in a popular rather than a scientific sense. To say that opium is a specific for bilious colic, or cholera morbus, or that alcohol is a specific for delirium tremens, merely signifies that, generally, these medicines are curative of the diseases named, but by no means so constantly as in the case of the true specifics, and also that they cure by virtue of properties which they manifest under all the circumstances in which they are employed. They fall under a general therapeutic law; whereas the curative operation of every one of the specifics mentioned has no evident relation to the effects which it produces upon healthy structure or function.

The investigations which of late years have taken place concerning

¹ Works, by SHAW, iii. 546.

the operation of medicines have led to an explanation of the ancient doctrine that certain of them especially affect particular organs. This peculiarity has been called their *elective action*. Some medicines tend to escape from the body through certain organs rather than through others, and in doing so, to exert a stimulant influence upon them, or, in addition, as in the case of certain glands, to modify their secretion. So the alkalis, and ammonia in particular, act upon the mucous membranes, and, in the case of the bronchia, dissolve or dilute the tenacious mucus which clogs them, and facilitate expectoration. Turpentine is excreted by the liver, and, being a solvent of the bile, tends to render its discharge more free. It is even supposed capable of dissolving biliary concretions. Digitalis and squill augment the urinary secretion by the addition of a large proportion of water. Mercury occasions an excessive flow of saliva. Or, to take examples from among the non-secreting organs, opium and alcohol affect the brain; iodine occasions atrophy of certain parts, viz., the mamma, the testis, the thyroid body, &c.; and ergot of rye acts upon the uterus.

In death from arsenic, more of that mineral has been found in the pancreas than in the kidney, and more in the lungs than in the liver. In poisoning by antimony, Dr. Nevins has found it in the liver before it could be found in the kidneys, and in these before it could be detected in the bones; and after the use of the drug had been long suspended, he found it in the bones, and not in the kidneys; and in these but not in the liver.¹

M. Coze, of Strasburg, has drawn the following conclusions from his experiments: 1st. That volatile substances introduced into the system, have a tendency to be eliminated by those organs which in a physiological state secrete gases or vapors, the lungs and skin, for example. 2. That substances which contain principles the same as those which naturally form part of a secretion, are eliminated by the organs which furnish this secretion. 3. That substances which enter into the composition of an organ, when given as a medicine are carried to that organ. 4. That among the substances which do not naturally enter into the composition of the solids or fluids of the animal system, there are some whose actions obey what may be called their general chemical character; thus acid substances are eliminated by acid secretions.²

The following is a detailed statement of the several organs and the medicines which manifest an elective affinity for them.³

The activity and nutrition of the *brain* are stimulated by all essential

¹ Liverpool Med. Chir. Journ., i. 223.

² Am. Journ. of Med. Sci., April, 1843, p. 438.

³ ALBERS, Allgemeine Arzneim., p. 149.

oils and the plants containing them, as valerian, the gum resins, many aromatics, also ammonia and musk. Alcohol and camphor, which in small doses have this effect, impair the energy of the brain when largely administered, and so do opium, prussic acid, nicotina, and conia.

On the *nerves of the eyes* opium and pulsatilla act as stimulants, belladonna and hyoscyamus as debilitants. These latter narcotics and stramonium paralyze the iris. Lachrymation is occasioned by onion, garlic, squill, and mustard.

The *spinal marrow* is excited by strychnia and all substances which yield it; quinia, tannin, and their salts, with theine and caffeine, act upon this organ also, the two former by diminishing and depressing its activity.

The *pharynx and œsophagus* are made to contract spasmodically by belladonna.

The *stomach* is incited to vomiting by antimonial preparations, sulphate of zinc, ipecacuanha, &c. That tartar emetic at least has a specific action on the stomach is proved by its operating as an emetic, however introduced into the system, and even when injected into the veins.

Purgatives have not perhaps so specific an action upon the *intestine* as emetics upon the stomach, but, as we have seen, aloes and gamboge, when applied endermically, purge. In general, however, their operation seems to depend upon their being irritants. But some are supposed to act upon particular portions of the intestinal canal. Mercurials affect the upper portion of the bowel, and aloes and colocynth the large intestine more particularly.

Of medicines that act upon the *liver*, mercury is the chief. Mr. Headland observes that even if we had no direct proof of this action, we might almost have affirmed that mercury increases the secretion of bile, from the obvious manner in which bilious symptoms yield to its operation. But in experiments upon animals, as it is elsewhere stated, the secretion of bile is augmented by the administration of mercury, and this substance has afterwards been found in the hepatic duct. Oil of turpentine renders the bile thinner and more abundant; coffee, on the contrary, makes it thicker and darker; alcohol increases its fatty constituents and those of the liver. Sulphates and tartrates are said to be cholagogues, and so is aloes; but although the experiments of Jörg appear to favor this view of the action of aloetic purgatives, it is not generally adopted; the coloring matter of the drug, it is thought, has been mistaken for that of the bile.

Iron, einchona, and mercury are said to act upon the *spleen*, but their action is only indirect. The spleen is essential to a proper ela-

boration of the blood, and hence, after protracted malarious disease, anæmia coexists with enlargement of the spleen. The two first named remedies promote the contraction of this organ by improving the constitution of the blood, either directly or through the increased activity of the digestive function. When the increased size of the spleen results from inflammation, mercury may remove the fibrinous deposit and promote the reduction of the organ. Iodine has the same effect. But in neither case can this operation be regarded as specific.

Iodine, bromine, and carbonate of potassa are said to have a special influence upon the *thyroid gland*. When goitre is a simple glandular hypertrophy, and is unaccompanied by calcareous, scirrhus, or medullary transformation, or even an aneurismal condition, these remedies, but the first two especially, appear to have a specific power to cure.

The *salivary glands* are particularly influenced by the acrid narcotics, tobacco, belladonna, and conium, and by mercury and iodine. All of these, except the last, appear to act as irritants of the glands; but the salivation produced by iodine ceases when the medicine is suspended.

The *mammary gland* in the female is acted upon by bromine, iodine, carbonate of potassa, and mercury. Under their use the fat attached to the gland is removed, as well as the glandular substance itself, and consequently during lactation they diminish the secretion of milk. This latter is increased by fennel, anis, and chervil (*Anthriscus cerefolium*), and diminished by sage and hyssop. Its qualities are altered by wormwood.

Conium and mercury are said to affect the *pancreatic* secretion.

Many substances increase the secretion of the *kidneys*, *e. g.* digitalis, colchicum, squill, the combinations of potassa with vegetable acids and with nitric acid. Aconite and colchicum increase the discharge of urates; copaiva, cubebs, and black pepper augment its animal constituents; and the secretion is augmented and variously modified by turpentine, copaiva, cubebs, juniper, senega, uva ursi, cantharides, cochineal, the salts of potassa above mentioned and other salts.

On the *urinary bladder* itself lime acts by diminishing its secretion, while the alkalies, and carbonate of potassa especially, increase it, as do also assafoetida, galbanum, petroleum, naphtha, and the empyreumatic oils. The ice-plant (*Mesembryanthemum crystallinum*) is said to impair the nutrition of the walls of the organ; and camphor and oily substances to diminish its contractility and excitability.

Iodide of potassium is reputed to produce atrophy of the *ovaries*, while iron and vanilla augment their activity. Savin may excite ovaritis.

Cinnamon and borax, as well as ergot, are held to be excitants of the gravid *uterus*; and borax, safin, myrrh, aloes, and iron tend to increase its congestion. Bird lime (*Viscum album*), when given continuously, is said to be a more active uterine stimulant than ergot, and, like it, to diminish uterine leucorrhœa and menorrhagia. It is stated to be the most certain of all remedies for these accidents of the menopause.

As special excitants of the *testes*, vanilla and spiced wines may be mentioned; but lupulin, camphor, and nitre reduce the action of these glands, and conium, iodine, and mercury induce their atrophy.

The secretion of the *bronchia*, and the shedding and reproduction of their epithelium, are promoted by ammonia and its preparations, especially the muriatic; by tartar emetic and other preparations of antimony; by substances furnishing a sweet extractive, such as liquorice; also by anis, fennel, eopaiva, cubeb, and the essential and empyreumatic oils. The following are said first to increase, but by continued use to diminish, the bronchial secretion: benzoic and succinic acids, fennel, seneka, birdlime, horehound, and veronica (*Speedwell*).

The *urinary passages* are specially stimulated by cantharides, which may provoke erections and strangury. Pepper acts also upon these parts as a stimulant, and the same is true of eopaiva, cubeb, Peruvian balsam, turpentine, &c. Camphor allays excitement of the urinary organs.

Sedatives of the *heart* and *bloodvessels* include digitalis, white and green hellebore, aconite, colchicum, and squill; the principal stimulants of the same organs are alcohol, wine, iron, and assafoetida.

Albers enumerates as special stimulants of the *skin*, elder flowers, linden blossoms, and solution of acetate of ammonia; as stimulating, while they excite it to healthy action, sulphur, antimony, dulcamara, guaiacum, benzoin, and empyreumatic oils; as diminishing the tendency to form fat, guaiacum, benzoin, and cantharides; as augmenting the deposit of fat, all oily and saponaceous substances; and as diminishing the sensibility of the skin, opium and conia, to which may be added ether, chloroform, aconite, &c.

The *muscles* have their excitability increased by strychnia, tea, and coffee; the opposite effect is produced by conia and nicotianin.

In diseases of the *bones* attended with a deficiency of animal substance in them, as in rachitis, oil and fat become specific remedies; mollities ossium, on the other hand, is successfully treated with calcareous preparations. Albers states that phosphoric acid, which in old and in recent publications is alleged to have a specific operation upon

scrofulous and rachitic affections of the bones, he has found, by repeated trials, to be wholly destitute of such a virtue.

Mercury and iodine have a peculiar influence upon diseases of the *absorbent* system, the former, however, chiefly in acute inflammatory disorders, and the latter in chronic affections, and both especially when a considerable deposit of organized or organizable effusion exists.

Affections of the *fibrous* tissue, as rheumatism and gout, appear to be peculiarly under the influence of aconite, guaiacum, cantharides, and iodide of potassium.

As the *blood* forms the channel through which many diseases are diffused, and as indeed they often directly depend upon its composition, it would be desirable to know what medicines modify its condition, and in what manner they do so. Of substances which are ranked as medicines, iron is the only one which directly augments the solid constituents of this fluid, all others, including saccharine and oleaginous medicines, are first either metamorphosed and vitalized by digestion, or else operate chiefly by promoting this process or that of nutrition. The influence of purely medicinal substances upon the composition of the blood is thus stated by Albers. Cinchona and the balsamic resins increase the red globules; cinchona and the bitter vegetable tonics and astringents augment the fibrin; oleaginous substances increase the fat; and salines, being absorbed into the blood, impede the absorption of oxygen, and hence, according to Schultz, prevent combustion of the tissues, and consequently operate as antiphlogistics. According to the first named authority, the blood-globules are diminished by bloodletting, water, iodine, and the acids; the fibrin by mercury, iodine, and the alkalies; and the fat by carbonate of potassa, iodide of potassium, and mercury. Of these statements it is probable that some are premature, if not unfounded. It is to be hoped, however, that future investigations will throw light upon this obscure department of experimental physiology, which must hereafter furnish the securest basis for a science of therapeutics, if such a science is possible.

INFLUENCES MODIFYING THE EFFECTS OF MEDICINES.

In estimating the effects of a given medicine, it is evident that much will depend upon its condition, and much, also, on that of the patient. In fact, it seems as if the fluctuating values of these two elements must necessarily and forever prevent the problems of therapeutics from being solved categorically. But this very circumstance renders it peculiarly important that we should learn as accurately as possible the value of

all those influences which modify the result produced by the mutual reactions of medicines with the economy, and thus diminish the chances of error in the treatment of disease. Such knowledge would always be difficult of attainment, even were medicines administered in their simplest forms and singly; but it oftener happens that combinations are prescribed, into which not only two, but many, ingredients enter. These are often altered by mutual chemical reactions, so as to produce a new compound possessing different qualities from either of its constituents; or, when this is not the case, their resulting effect is determined by the sum of the several substances employed, and is consequently complex, and can seldom with certainty be anticipated. It may be useful to describe more particularly these sources of error, which, being known, become so many motives to circumspection in practice.

Diversities in Medicines themselves.—Medicines derived from the vegetable kingdom vary in quality with the soil in which they grow, the climate of the locality where, and the season in which they are gathered, and also the care employed in their preparation. The hemp of northern Europe and of the United States, possesses no remarkable medicinal qualities, while that of Asia (*Cannabis Indica*) exudes a juice which is a powerful narcotic. All extracts made from the roots and herb of plants are comparatively worthless if obtained when the juices are diluted and feeble in the spring. The manner in which plants are dried, the degree of heat employed in obtaining their extracts, or in distilling or otherwise preparing chemical compounds, may make all the difference between an inert and an active medicine. As nearly all medicines undergo change by exposure to the air, their efficacy will depend greatly upon this circumstance. Many will lose their active properties, including all whose virtues depend upon essential oils, or proximate principles which undergo decomposition by exposure to air or light; others, and particularly tinctures of non-volatile substances, by the evaporation of their menstruum become stronger on exposure to the air; and hence narcotic tinctures, and particularly laudanum, have frequently proved poisonous when administered in the prescribed doses.

The *form* of a medicine influences its operation. Pulverizing a solid substance renders it more active by facilitating its solution in the gastro-intestinal secretions, and consequently rendering its absorption speedier. At the same time its action upon the gastro-intestinal mucous membrane is diminished. A small lump of camphor taken into the stomach may occasion violent local symptoms, but the same quantity dissolved in oil will not derange the stomach, but will

more surely and speedily than by the other method, produce cerebral disturbance. All substances administered in powder are active in proportion to the fineness of their division. Hence *solutions*, which are only minuter divisions of substances than powders, act more rapidly and energetically upon the system at large than these latter, while, at the same time, their local action is less intense. On these accounts natural mineral waters are much more active than artificial solutions containing the same ingredients.

The action of a medicine is greatly modified by its *dose*. Although such a statement needs no illustration, it may not, at first sight, be so apparent that these varied effects of the same medicine constitute one of the most precious resources in the treatment of disease. Tartar emetic in the dose of one grain, properly diluted, occasions copious vomiting, but in the dose of one-twentieth of a grain and repeated at intervals of an hour, it may, without exciting nausea, reduce the pulse in fever, and promote diaphoresis. Ipecacuanha, which in one dose vomits, in another promotes expectoration. Small doses of opium excite the brain, large ones stupefy it. In fact, the dose and time of its repetition affect the operation of a medicine, as much as its inherent qualities. The term *dose*, then, is a relative one; it designates a quantity which must vary with the peculiarities of the patient, and the nature and stage of his disease. Yet there is recognized for every medicine what may be called its officinal dose, and which is the quantity required to produce the effect for which the medicine is most distinguished. Thus, when it is said that the dose of opium is one grain, and of ipecacuanha twenty grains, it is understood that the former quantity will occasion sleep, and the latter vomiting, in adults presenting an average degree of susceptibility to the influence of these medicines.

When medicines are prescribed for the purpose of exerting a sustained action upon the system, they are given in *divided doses* and at comparatively short intervals of time. Often the effect is totally different from that which the whole quantity administered at a single dose would have produced. Thus, ten grains of calomel taken at once will purge, but divided into twenty doses and given at intervals of three hours, it will probably salivate. Many saline solutions taken in the former manner will act as cathartics, but in the latter become diuretic. In fact most of the active substances (mercury, iodine, arsenic, &c.), which, when given in divided and even minute doses, exert a decidedly curative action in many chronic and even some acute affections, become poisons if administered at once in large doses.

The doses of medicines vary with the part of the body to which they

are applied. Although it is not easy to lay down a rule on this subject which shall be of general application, the following, proposed by Oesterlen, may be usually followed. If the dose of a medicine by the stomach, say five grains, be taken as unity, the quantities required for other parts will be—

For the sound skin,	3 to 6 times, or from 15 to 30 grains.					
“ ulcers and suppurating sores,	2	“	4	“	10	“ 20 “
“ endermic application,	1	“	3	“	5	“ 15 “
“ the colon (by enema),	2	“	4	“	10	“ 20 “
“ the eye,	$\frac{1}{2}$	“	1	“	2	“ 5 “

Diversities presented by Patients.—Influence of Race, Climate, Season, &c.—It is difficult, in reference to the present subject, to separate the influences of race and climate, for it is generally found that the foreigner who is acclimated and has also adopted the mode of life peculiar to the natives of his new residence, acquires a similar susceptibility to the action of medicines. Several features distinguish the susceptibility of the inhabitants of hot from that of the natives of cold climates. In the former all diaphoretic agents produce a speedier and fuller effect than in the latter, while in these the action of diuretic medicines is stronger. In warm climates there is a remarkable susceptibility to the operation of purgatives, and the stools are apt to be very bilious. The use of mercury to produce constitutional effects is also dangerous, not only on account of its destructive effects upon the gums, &c., but also because it is apt to induce a state of nervous erethism and permanent debility. The violent effects of narcotics witnessed among Oriental nations are unknown among the inhabitants of the temperate regions of the West. Even between the north and south of Europe a similar difference has been observed; and Dr. Harrison affirms that in Naples patients were made amaurotic by the same doses of extract of hyoscyamus they were accustomed to take in England. In this case something was probably due to the greater strength of the Italian extract. Albers states that the inhabitants of elevated tracts of country tolerate smaller doses of medicine than those of the seaboard, and that Hollanders require twice as large doses as the inhabitants of Bonn. He also mentions that Englishmen residing in the latter place are obliged to employ smaller doses of medicine than they were accustomed to use at home. The remarks just made respecting climates are in some degree applicable to differences of seasons, when these are extreme, as in the United States. Thus, during the protracted heat of certain summers in this country, there is a general tendency to irritability of the bowels, and an increased susceptibility to the stimulant action of narcotics. In this connection the *epidemic*

constitution is deserving of notice. With a tendency to susceptibility of the bowels, such as prevails during epidemics of cholera, the smallest doses of purgative medicine produce hypercatharsis; when diseases all assume a bilious type, such remedies are, on the contrary, well borne; and during the prevalence of a typhous constitution, alcohol and other stimulants may be required in diseases which usually call for a vigorous antiphlogistic treatment.

An attempt has been made to determine the peculiar susceptibilities of the several *temperaments*. It has been said, in general, that the nervous and sanguineo-nervous temperaments are affected by small doses of medicines, and particularly by those of the stimulant and narcotic classes, whereas the phlegmatic and bilious temperaments imply a remarkable insensibility to the operation of drugs. It is only in marked examples of these several temperaments that the distinctions here alluded to become of real value, and such cases are comparatively rare.

Age.—It seems but natural that medicines should operate differently in the earlier periods of life, on the one hand, when the function of nutrition and the nervous susceptibility are in their fullest exercise; on the other, in the adult life when both organic and animal functions are stationary, and finally in old age when both are tending to decay. During infancy and childhood more dependence is to be placed on the recuperative powers of nature than upon the operation of drugs. At this age all injuries to the organism are repaired with wonderful rapidity, and even when the functions are so exhausted that death seems inevitable, recovery often takes place by the sole power of the vital force. Therefore, it is said, "childhood is the age of resurrections." Appropriate diet, and the exclusion of all disturbing influences are then the essential remedies in acute affections, and change of air and food in chronic diseases. But, as in many cases, this expectant method will not suffice, and medicines must be given, those should be selected which operate mildly, and which, even in an overdose, are not dangerous. As a general rule, depletion should be avoided; the cases are very rare in which it is necessary until after the seventh year, and they are not frequent even during adolescence; for other evacuants, at this period, impress the system powerfully. Blisters should always be applied with care, in infancy, lest sloughing be produced. Of internal medicines the mineral acids, and the metallic salts, especially those of mercury and arsenic, are to be avoided. As mercury rarely salivates children under the age of three years, we are deprived, in their cases, of a criterion by which to graduate its dose. Antimonials, even in minute doses, sometimes depress the system of young persons to a dangerous degree, and may even operate as fatal

poisons. A similar remark is applicable to narcotics, particularly when administered to children exhausted by sickness. In the Article on Opium illustrations of this statement will be found.

In old age, on the other hand, depletion must be used with extreme caution, and, when necessary, the sinking which is apt to ensue must be guarded against by gentle stimulants. Indeed, these latter should be associated with nearly all the methods of treatment used for the aged, for "wine is the milk of old age." Purgatives are generally required in larger doses than for adults, and should, as far as possible, be given in a liquid form, and selected from the resinous class, and also associated with bitter tonics. Salines are, for the most part, to be avoided. Blisters and rubefacients must be cautiously employed on account of the impaired vitality of the skin, and, on the same account, the endermic method is not eligible in old persons. Metallic preparations are usually to be avoided as much as during childhood, and narcotics are apt to produce serious congestion of the brain. This is particularly the case with opium. Attempts have been made to form a scale of doses of medicines appropriate to the different periods of life, and, although none of them can be considered accurate, they may serve as guides until personal experience renders them unnecessary. The table of Gaubius is one of the simplest, and is as follows. The dose for an adult being taken as unity,¹ there may be given to persons

Under 1 year	$\frac{1}{15}$ to $\frac{1}{12}$ of the dose.	At 7 years	$\frac{1}{3}$ of the dose.
At 2 years	$\frac{1}{8}$ of the dose.	" 14 "	$\frac{1}{2}$ "
" 3 "	$\frac{1}{6}$ "	" 21 "	$\frac{2}{3}$ "
" 4 "	$\frac{1}{4}$ "		

¹ Hufeland considered a full dose the quantity which may be taken between the ages of 25 and 50 years, and the following table is presented as the results of his experience:—

$\frac{1}{2}$ to 1 month	$\frac{1}{2}$ to 2 parts.	3 to 4 years	16 to 18 parts.
1 " 2 months	2 " 4 "	4 " 5 "	18 " 20 "
2 " 3 "	4 " 5 "	5 " 10 "	20 " 25 "
3 " 4 "	5 " 6 "	10 " 20 "	25 " 35 "
5 " 7 "	6 " 7 "	20 " 25 "	35 " 40 "
7 " 9 "	7 " 8 "	25 " 50 "	40 " "
9 " 11 "	8 " 9 "	50 " 70 "	40 " 30 "
1 " 2 years	10 " 13 "	70 " 80 "	30 " 25 "
2 " 3 "	13 " 16 "		

Albers gives the following table formed from careful observation:—

Age.	Dose.	Age.	Dose.
1—60 days	$\frac{1}{16}$	15—20 years	$\frac{3}{4}$
2—12 months	$\frac{1}{8}$	25—60 "	1
1— 5 years	$\frac{1}{3}$	60—70 "	$\frac{7}{8}$
5—10 "	$\frac{3}{8}$	70—90 "	$\frac{7}{8}$
10—15 "	$\frac{1}{2}$		

A simpler method than the above, or than those given in the note, is that of Dr. Young, viz.: For children under twelve years the doses of most medicines must be divided in the proportion of the age to the age increased by 12; thus at two years the dose would be $\frac{2}{2+12} = \frac{1}{7}$.

This formula is in fact an approximate generalization of the table of Gaubius, but both differ materially from the tables in the foot-note, except for the years between 10 and 15.

Sex.—As, in general, females are more susceptible to impressions than males, the action of medicines upon them is apt to be more prompt, active, and irregular, than in men; and, therefore, it is generally advised that medicines should be administered to them in smaller doses. But this rule is by no means of universal application. There are masculine women and effeminate men in great numbers, and in constitution even more than in character. But even apart from this circumstance, women support active treatment, as they do surgical operations, better than men. They are more easily affected than men by narcotic and other nervine stimulants, but they are not more susceptible than the other sex to the operation of purgatives. During menstruation, pregnancy, and lactation, the female constitution acquires peculiar susceptibilities. At these epochs all active treatment, which is not imperatively demanded, should be avoided, and the use especially of strong emetics or cathartics and all painful applications. Iodine and mercury must be cautiously administered in pregnancy; and during lactation all medicines, not absolutely necessary, which are capable of impregnating the milk. Of these opiates are especially to be guarded against. Bitter vegetable substances, also, are apt to impart an unpleasant flavor to this secretion, and indispose the child to nurse. At the menopause great circumspection in the use of medicines is required, on account of the peculiar susceptibilities, at this epoch, derived from the reproductive organs, and also because it is then that many organic diseases originate, which may, by injudicious treatment, be hurried into premature development.

Habit.—The same power which the human constitution possesses of adapting itself to every variety of climate and mode of life, is shown in the operation of medicines upon it. When these do not tend to disorganize the tissues, they gradually lose their power of exciting reactions in the system, and, therefore, must be administered in gradually increasing doses. Alcoholic liquors, which occasion intoxication very speedily in those who are unused to them, may, as it is well known, at last be taken in as large quantities as the stomach will hold without producing their former characteristic effects. Opium eaters learn to

use enormous quantities of this drug without experiencing narcotism. Trousseau mentions the case of a woman who was in the habit of consuming nearly an ounce of opium every day. Purgative medicines also gradually lose their power of stimulating the intestine, a circumstance which renders the treatment of habitual constipation by them extremely unsatisfactory. It is difficult to account for this peculiarity; we only know that it is a property of animal organization. It may, to some extent, be due to the saturation of the tissues at the point of application, with a medicinal substance, but is, more probably, attributable to the nervous system. We know that the peculiarity of the sentient part, if not the whole, of this system, is to pass through periods of alternate action and repose, and that the latter state is always proportioned to the former, in duration and degree. If the action be violent or prolonged, the reaction or exhaustion will be extreme and protracted. We know, further, that repose restores a function to its original vigor; as sleep refreshes the exhausted body, so does the suspension of a particular stimulation allow a part to regain its original susceptibility. In recovery from the fatigue produced by muscular and mental exertion, it is evident that the recuperation, if not literally vital, is at least restricted to the organ of animal life, the nervous system. Hence, whatever merely physical causes may tend to lessen the susceptibility to medicines which are repeatedly given, we must not leave out of sight the important law of the nervous system which has been referred to. An apparent exception to the law that medicines must be given in increasing doses to maintain a uniform effect, is to be found in mercury. When once the system has been brought under its influence, very small additional doses will renew the original manifestations of its action. In this case, and in that of lead, and perhaps of strychnia and some other substances, the medicine saturates the economy, and remains in it for a long time; wherefore, every additional dose, even though a small one, may be expected to develop its peculiar effects. Another exception is presented by the operation of emetics, provided they are not administered in rapidly successive doses. In the latter case they obey the general law, and "toleration," or insensibility to their action, is speedily induced. But in the former instance, equal effects may arise from progressively smaller doses, and at last the idea, even, of the emetic medicine may excite nausea. This fact is to be explained by the influence of mental states in general, upon the functions of the stomach. Diaphoretic medicines appear, also, not to fail of their effect when frequently repeated. Indeed, when they have been used

for a long time, diaphoresis may be excited by a variety of stimulant influences which ordinarily would not produce such an effect.

Idiosyncrasies.—Many persons are affected by certain medicinal or other agents, in a manner quite peculiar to themselves, and of which no rational explanation can be given. Usually it is a permanent peculiarity, in other cases it exists only during menstruation, pregnancy, or the exacerbations of some nervous disorder. We have known a gentleman who was always attacked with coryza if the smallest quantity of powdered ipecacuanha approached his face. This medicine more frequently occasions a paroxysm of dyspnoea. Albers relates that a person whose mother also evinced the same peculiarity, experiences pain in the umbilical region whenever her feelings were affected, either agreeably, or the reverse; and medicines which, like mercury and tartar-emetic, are somewhat irritating, produced the same effect. Marc has collected a large number of cases bearing upon this subject, and the following, selected from among them, may suffice for illustration.¹ Haller mentions a female whom syrup of roses purged violently; Whytt one in whom a dose of magnesia caused shuddering and unusual trembling; Tissot refers to a person whom the smallest quantity of sugar caused to vomit; Déjean, a case in which honey, either internally or externally, acted as an irritant; Wagner, an instance of a person who vomited on taking the least dose of rhubarb, and Marc relates the same peculiarity of himself. In other cases opium has caused salivation, vinegar hemorrhage, mercury in the minutest dose, salivation, opium wakefulness or vomiting, &c. These and similar cases which, in the aggregate, are very numerous, and the still larger number which, without being so eccentric, are still departures from the general rule, ought not to be lost sight of by those who think it possible to reduce the operations of the living organism to laws as fixed as those of chemistry or physics.

Mental Influences.—Sentiments of partiality or aversion, and indeed, all preconceived ideas respecting the operation of medicines, in many instances, determine their effects. The cures of the charlatan, whether he be an itinerant vender of panaceas, or a smug exhibitor of mesmeric jugglery, and those of the self-deluded enthusiast confident in an imaginary power, are often real, and at times so wonderful as to pass with the populace for miraculous. Yet they nearly all depend upon the patient's being impressed with a firm faith in the success of the prescribed remedy. The same power, honestly employed, is the secret of the success of many physicians who, inferior, perhaps, to

¹ Dict. de Méd. in 60 vol., xxiii. 498.

others in knowledge of disease and the use of the medicines, are superior to them in their ability to control the will of the patient, and inspire unquestioning faith in the remedies which they employ. Philosophy is never so unfitly introduced as at the bedside of the sick. By a judicious use of the patient's belief, not only may recognized medicines become the means of accomplishing purposes which they are physically incompetent to fulfil, but inert matter, imbued with faith, may produce important physical effects. Simple neutral substances, such as a few grains of salt, or bread pills, may induce vomiting or purging; some colored drops may assuage a violent nervous headache, excite diaphoresis, or promote sleep. In this connection, it is sufficient to refer to the salutary influence of cheerfulness and hope, and the depressing effects of a dull tone and despairing manner, not only on the comfort of the sick, and their progress towards health, but absolutely on the issue of their sickness.

Influence of the Form of Disease.—It has already been noticed how wide a difference there often is between the operation of medicines in health and in disease. It should be borne in mind that whenever the secretory function is impaired, from whatever cause, absorption also is less active than natural; in all fevers and sthenic inflammations mercurials and narcotics operate slowly; when the kidneys are inflamed, stimulant diuretics only diminish the secretion of urine, and when the bronchia are in a like condition, direct expectorants are mischievous. In those cases it may be conjectured that the very infarction of the affected organs with blood prevents the medicines from reaching their secreting vessels, and from being eliminated. So, too, in febrile affections of a low grade, with more or less torpor of the nervous system, and even in the functional depression of the brain which marks some forms of insanity, in cerebral oppression by serum or blood effused within the cranium, the susceptibility of all the organ is impaired, and emetics, purgatives, &c., operate only in unusual doses. Still more remarkable is the insusceptibility to narcotics in certain nervous affections, as delirium tremens and tetanus. In a word, whatever conclusions regarding the action of medicines may have been reached by experiments upon the healthy, or by general observation of the sick, every new case may present peculiar modes of this action depending upon conditions peculiar to the patient's constitution, and the nature, stage, or complications of his disease.

THE ADMINISTRATION OF MEDICINES.

The Forms in which Medicines are Employed.

The physical qualities of a medicine, such as its solubility, bulk, taste, &c., determine in some degree whether it shall be given as a solid, liquid, vapor, or gas; but the use of one or the other of these forms also depends upon the natural character of the part to which the medicine is applied, and the susceptibility it may have acquired or lost in disease. As a general rule, that form should be selected which is most favorable to the proposed operation of the remedy, the solid being preferable when a local action only is contemplated, and a liquid or gaseous form when absorption of the medicine is intended. Between these two extremes there are preparations which graduate the solubility of medicines, by presenting them to the absorbing surface in a more or less finely divided condition, or in union with substances which facilitate their administration, and regulate the rapidity with which they can be absorbed. The following are in general use.

POWDERS (*pulveres*) are obtained by pounding, grinding, filing, levigation, precipitation, &c. Their general action is most marked when they are most finely divided. Thus, a substance obtained by precipitation is more active than the same procured by pulverization, as in the case of milk of sulphur and washed sulphur. On the other hand, a coarse powder, while it is less readily absorbed, exerts a more powerful local action, and one which may even become poisonous, as in the case of the metallic salts. Hence, it is a general rule to administer only the finest powders, and also to prevent their aggregation in masses by means of some excipient in which they are uniformly diffused. Sugar, gum, powdered extract of liquorice, &c., and, in the case of light powders, water sweetened or otherwise flavored, are used for this purpose. If it is intended to render the action of the medicine gradual, an insoluble excipient, such as powdered liquorice root, may be selected. For substances which are intended to be absorbed from the stomach and bowels, and which must be repeatedly administered, this form is ineligible; for the powder is apt to occasion disturbance of the digestion, or to accumulate in the intestinal canal.

ELECTUARIES (*electuaria*) are soft solids made by mixing powdered medicines with honey or syrup. This form is adapted to combining soluble and insoluble substances in the same dose. A *conserve*, or *confection*, is an electuary containing the leaves, seeds, or other parts of fresh plants. But few medicines are exhibited in this manner, because

the proportion of saccharine matter contained in them is objectionable. Laxative confections, as the confection of senna, are exceptions to this rule.

PILLS (*pilulæ*) are small globular masses weighing from one to four grains, or, if metallic, not more than from six to eight grains, and containing one or more medicinal substances. When these are not sufficiently cohesive, they are rendered so by the addition of a vegetable extract, or gum, soap, syrup, or honey. They are prevented from cohering, when placed together, by being sprinkled with lycopodium or liquorice powder, or with magnesia, and their taste may remain unperceived if they are coated with gold or silver leaf, or with sugar or gelatin, which are preferable from their greater solubility. Two small and delicate capsules of gelatin, made to fit into one another by their open ends, and of size sufficient to hold a pill, are sometimes used for administering this form of medicine. Nearly all pills should be used before they become hard. Those composed of resinous materials are especially liable to objection if this precaution be not observed. Slow solution is occasionally advantageous; thus old opium pills are preferred in cases of intestinal colic with diarrhœa, because they extend their local action over a larger surface of the bowel.

Boluses are large and soft pills; they are sometimes formed of electuaries or conserves, and are best administered in wafers made of flour and the white of egg. Liquids of an offensive taste, and which are given in small doses, such as copaiba, are sometimes inclosed in ovoid gelatinous capsules which effectually prevent their taste from being perceived.

LOZENGES or TROCHES (*trochisci*) are, properly speaking, flattened disks with rounded (*rotulæ*), serrated, or otherwise formed edges, made usually with gum and sugar, and more or less medicated. Some medicinal preparations of a cylindrical form (*bacilli*) are incorrectly called lozenges. They are intended to dissolve slowly in the mouth, and to maintain the moisture of the fauces, as well as exert some medicinal effect upon the latter, or upon the system generally.

Several solid forms of medicines are used exclusively for external application. Among these are CATAPLASMS or POULTICES (*cataplasmata*), which are made of soft materials (generally bread-crumbs, ground flaxseed, or Indian corn meal), capable of retaining moisture and of closely covering the part to which they are applied. A tissue, called *spongio-piline*, has been invented to fulfil the same indications. These applications are used as vehicles for heat, moisture, and various anodyne, astringent, rubefacient, and other medicines. *Ointments* are medicated preparations of fats and oils for external use. *Cerates* differ from

ointments in containing wax, which gives them a firmer consistence than these latter. Both are employed to protect irritable portions of the skin from the air, and at the same time to apply medicinal substances incorporated with them. Generally they are used to allay irritation, but sometimes, on the contrary, to produce it, as in the case of ointment of cantharides, of tartar emetic, &c. In *plasters* the basis is an adhesive substance, generally resin, wax, or a compound of oil and litharge, and they are intended to adhere to the skin so as to give it and the subjacent parts support, while it protects them from external impressions, and by means of medicinal ingredients acts directly upon the integument, or the parts beneath it, or through these upon the rest of the economy.

EXTRACTS (*extracta*) "are solid substances resulting from the evaporation of the solutions of vegetable principles." Alcohol, acetic acid, and water, are the menstrua usually employed for this purpose, when extracts are not procured by inspissating vegetable juices. They vary in consistence from that of a soft paste to that of a hard and brittle solid, and may be administered in pill, solution, or mixture.

The *liquid forms* of medicines are those which contain their active properties in water, alcohol, ether, vinegar, honey, or oil. They are administered both internally and externally. Of the different menstrua named, some extract certain constituents only of natural bodies, and others certain other constituents. But the most general solvent of medicinal elements is alcohol, and next to this water, and each extracts most perfectly what it is competent to dissolve, when it is aided by heat.

The following are the principal liquid forms in which medicines are administered.

MIXTURES (*misturae*), as distinguished from solutions, are liquid preparations containing one or more ingredients, which are not perfectly soluble in water. Thus tinctures of resinous substances precipitate these latter on the addition of water, and hence all resins, and gum-resins prescribed in an aqueous vehicle, must be suspended by means of mucilage, albumen, sugar, or some equivalent substance. Other medicines, whose weight, as well as insolubility, renders them difficult of administration in water, are given in this manner. Chalk mixture, ammonia mixture, and the compound mixture of iron are examples of this form of preparation. An *emulsion* is, properly speaking, a mixture in which oil and water are mixed by means of mucilage, or albumen and sugar. The ingredients for making this preparation sometimes exist in nature, as in the seeds of various fruits, *e. g.*, the

almond. A *julep* is a sweetened or acidulous mixture, but the term is often applied to mixtures generally.

SOLUTIONS (*liquores*) are watery liquids containing medicines wholly soluble in that menstruum. Although this form of preparation and its title are frequently used in the U.S. Pharmacopœia, that work does not recognize a separate class of medicines under the name *liquores*. Vinous, acetous, and other solutions are described as *wines*, *vinegars*, &c.

INFUSIONS (*infusa*) are watery solutions prepared by digesting vegetable substances in cold water, or in hot water below the boiling point, so as to separate their active from their inert portions. Cold water is preferable as a menstruum when the medicine contains a volatile principle which may be driven off by a moderate heat, and also when it contains starch, which would cause the infusion to ferment, unless kept at a low temperature. But, although hot water is liable to this objection, it has the advantage of coagulating vegetable albumen, which is contained in all vegetable juices, besides extracting a larger proportion of the medicinal ingredient. Infusions are prepared by simply macerating medicinal substances in water, or by *percolation*.

DECOCTIONS (*decocta*) are watery solutions of fixed vegetable principles obtained by boiling. They have the advantage over infusions of greater rapidity in the preparation, and greater strength, but the disadvantage of a loss of the volatile principles of the substance employed. The latter objection may be diminished by conducting the process in a covered vessel, and for a short time only.

FLUID EXTRACTS (*extracta fluida*) are inspissated solutions of the active properties of vegetable substances obtained by means of ether or diluted alcohol. The former is used to extract volatile oils and resins, as in the case of cubebs and valerian, and the latter certain peculiar principles of a different kind, as those of scenna, rhubarb, and sarsaparilla. The method of displacement is generally employed, and the resulting solution evaporated to a proper consistence. In some cases sugar is added to prevent fermentation.

MEDICATED WATERS (*aque medicatæ*) are prepared by the distillation of water from dried, or preferably, from fresh vegetables, or by mechanically impregnating pure water with a medicinal substance. Of the latter description, are carbonated and camphor water; of the former, the aromatic waters when properly made. They are now, however, prepared in a slovenly manner, by mixing water with essential oils by means of agitation with carbonate of magnesia. This method, which is officinal, produces a stronger water than the other method, but one destitute of the delicacy which the old process secured.

TINCTURES (*tincturae*) are solutions of medicinal substances in alco-

hol. Their Latin name is derived from the circumstance of their being always colored. The only exception to this rule is tincture of camphor. They become turbid on the addition of water, which combines with the alcohol and precipitates the substance dissolved in it. There are two sorts of tinctures, the one prepared with officinal, and the other with diluted alcohol.

SPIRITS (*spiritus*) are tinctures of volatile principles prepared by distillation, or, as is now the custom, by dissolving the volatile principles in alcohol or diluted alcohol.

WINES (*vina*) are solutions of medicinal substances in Madeira, Sherry, or Teneriffe wine. They differ from tinctures and spirits in containing less alcohol, and being, therefore, less stimulating.

VINEGARS (*aceta*) are preparations in which cold distilled vinegar or diluted acetic acid is used to extract the active qualities of medicines. They have no special advantages, and, except the vinegar of opium, or *black drop*, are but little used. The preparation just named is supposed to exert a less stimulant effect, and to derange the stomach less, than the tinctures of opium.

SYRUPS (*syrupi*) "are concentrated solutions of sugar in watery fluids, either with or without medicinal impregnation," and are either simple or medicated. They serve to prevent decomposition in vegetable substances, and to mask the disagreeable taste of numerous medicines. Without great care, however, they are liable to ferment.

HONEYS (*mellita*) are solutions of medicinal substances in honey. They are seldom used internally, sugar having taken the place of honey in numerous preparations which were formerly made with this latter.

VAPORS AND GASES.—A few substances have been applied in the gaseous form to medicinal purposes. Such are oxygen, chlorine, and carbonic acid. But they have not answered the expectations originally formed by those who proposed them. Vapors have, in great variety, been applied to the skin and bronchial mucous membranes for the cure of diseases. In the former case the patient is inclosed, except his head, in a wooden box or other convenient receptacle, and surrounded with the fumes of the body which is intended to act upon him. The vapors of mercurial preparations, of sulphur, iodine, &c., have been used in this manner. The latter method is used for introducing a variety of medicines into the system, through their rapid absorption by the pulmonary veins. Sometimes the apartment occupied by the patient is impregnated with vapors, such as those of chlorine and tar; in other cases the patient is made to breathe from a sponge, or cloth, or an instrument called an inhaler, the emanations of volatile agents,

such as ether, chloroform, and various narcotic tinctures. The fumes of certain substances in combustion, such as stramonium, opium, belladonna, camphor, nitre, may be inhaled through such an instrument, or a common tobacco pipe.

The Art of Prescribing.

An essential preliminary to the successful use of medicines, is an accurate knowledge of the disease they are employed to cure. Not that a knowledge of the intimate nature of the disease is necessary, but only of those phenomena by the enumeration of which it is defined, and which enable us to discriminate between it and all analogous morbid conditions. The cure of intermittent fever, of whose nature we are ignorant, is easier than that of pneumonia, the anatomical elements of which are known. Without such knowledge, experience is deceptive and valueless; and, on the other hand, when it is possessed by those who investigate the curative effects of medicines, it gives to their results a precision which is at once recognized by the medical world, and impresses a permanent modification upon the healing art. Hardly less important as a groundwork for therapeutics, is the recognition of the various states which a patient may pass through in the course of a disease. In the greater number of diseases, in all, indeed, which are not of a specific nature, the appropriate curative remedies are very different at different periods of the attack. Medicines are prescribed for the purpose of bringing about, or of promoting certain changes, the evolution of which belongs to the normal progress of the disease. The remedies must vary with this latter, and, during its course, may require to be of dissimilar, and even opposite natures; for it constantly happens that an attack which has called for sedatives at its commencement, requires stimulants before its close. The successful practitioner is not he who, besides possessing diagnostic skill, is abundantly furnished with medical prescriptions for all diseases, but he who, in every case, knows not only what are the remedies adapted to remove the dominant and permanent morbid element, but who also knows what are the appropriate means of dissipating every subordinate derangement, and of influencing every function in such a way as to concur in the prime object of bringing the disease to a safe termination. This is a knowledge which can be very imperfectly obtained from books. It is the result, in most cases, of long practice in medicine by a man whom nature has fitted for its attainment. Few physicians are so highly endowed. It can only be communicated to pupils by a skilful teacher in daily, or still more frequent visits at the

bedside of the sick. We renounce, therefore, any attempt to reduce such knowledge to written rules. In this place, we shall merely endeavor summarily to describe the conditions affecting the successful employment of medicines which arise out of the mode in which they are administered.

Medicines may be incompatible with one another because their modes of action are different, or because their chemical constitution involves their mutual antagonism or their decomposition. To unite such medicines in the same prescription appears to be illogical; and, undoubtedly, in physics, if opposing forces so combined are of precisely the same amount, and of exactly opposite natures, they neutralize and destroy one another. But in medicine it is far otherwise in the greater number of cases. A third substance may arise from the union of two, possessing in a mitigated degree the properties of both, and hence a large number of the most efficient medicines owe their virtues to being compounded of antagonistic substances. Just as in dietetics and the culinary art, the due admixture of the strong and weak, the acid and the sweet, of animal and vegetable food, produces compounds the most agreeable to the palate and the easiest of digestion. The union of a stimulant and a sedative, as of opium and ipecacuanha in Dover's powder, produces an effect which neither is competent to produce alone. Indeed, however desirable simplicity in formulæ may be, there is every reason to believe that the skilful association of medicines of different qualities is one of the most important, as it is one of the most difficult, departments of therapeutics. It was anciently, and, until the present century, a universal practice; and if the formulæ of other periods appear to us monstrous from the number and incongruity of their ingredients, we should remember that they only prove the abuse of a principle which is founded in truth. Although it cannot be denied that it is much easier to judge of the operation of remedies when they are given singly, it may not also be easier at the same time to cure diseases by simple prescriptions. It is perhaps not wise to reject the experience of all time for the sake of a doctrine which is not yet proven to be true.

It may be urged, and it is very certain, that simplicity is preferable to complexity in prescriptions, whenever the end in view can be attained by the former; and it must also be admitted that routine and an almost superstitious want of discrimination engendered the farrago of drugs in many old formulæ. The chemical and other experimental researches of modern science have also revealed, more clearly than they were known before, the limits of the powers of medicines, and banished from the pharmacopœia numerous substances entirely destitute of

medicinal efficacy. Yet it is none the less certain that the more simple, convenient, and, as they are termed, elegant preparations of modern pharmacy, are far from possessing, in all cases, the virtues of the drugs from which they are procured, and to which they are assumed to be equivalent. Morphia is not the equivalent of opium, nor quinia of cinchona, nor, we feel assured, does any simple combination of the former with an aromatic or an astringent possess the precise qualities of those "monstrous compounds" theriaca and diascordium.

Substances which are regarded as chemically incompatible, may nevertheless be medicinally efficacious. Yellow wash and black wash are valuable applications to certain forms of ulcers, yet the one results from the mixture of the chemically incompatible corrosive sublimate and lime-water, and the other from that of calomel and lime-water. Acetate of lead and opium, forming one of the most frequently used of all combinations for arresting internal hemorrhage, &c., produce acetate of morphia and an insoluble meconate of lead. In this, and in many similar instances, it is probable that the acid secretions of the stomach, or the alkaline ones of the duodenum, restore the precipitated compound to activity by rendering it soluble anew. How far this restorative agency may be exercised in other cases of apparent incompatibility it remains for observation and experiment to decide. Medicines intended for external application have not the benefit of this influence, and care should be taken, in prescribing them, lest an insoluble compound be produced which cannot be advantageous, and may prove irritating. Solutions of nitrate of silver, or acetate of lead, intended to be applied to the eyes or to an ulcerated surface, should not be associated with a vegetable astringent, for they will form insoluble compounds with its tannin. Or, if laudanum be added to such solutions, insoluble meconates of lead or silver are produced.

The *doses* of medicines are the quantities ascertained by experience to be necessary for producing their curative effects. We have elsewhere referred to the different action of medicines in health and disease. In the former, as a general rule, larger doses are necessary to produce effects than in the latter, because the power of resistance in the organism is greater, and the susceptibility of the parts to which medicines are applied is less. But the reverse of this is sometimes the case, and through disease, either local or general, the susceptibility of a part or of the whole organism is blunted. These extreme conditions being recognized as capable of modifying the doses of medicines, it is evident that the latter must also vary with every degree and kind of departure from health; in different diseases, that is, and in the several stages of each disease. The standard dose of a medicine is, therefore, to

be regarded only as an indication, but not as a rule, for its prescription. The age and sex of the patient, the nature, stage, and complications of the disease, and innumerable incidents determined by the peculiarities of the individual case, must all be allowed a degree of influence in determining the first dose of a medicine. Afterwards its increase or diminution must be decided according to the effects which it produces, or seems to produce.

No more difficult problem exists than to determine how far the phenomena succeeding the administration of a medicine are due to this latter. To impute them all to it when they are favorable, and to the disease for which it is given when they are otherwise, is, perhaps, the natural tendency of the mind, and it certainly is the resource of charlatanism. But the more closely the natural history of disease and the effects of remedies are studied, the more evident does it become that we are in the habit of attributing too little efficacy to the curative energies of the system, and too much to medicines. If it were always possible to determine what precise effect should be produced, and what remedy and what doses of it are required for the production of that effect, medical art would soon assume the consistence of a science, and the results of its practical application might be predicted with certainty. But, in the absence of any such ground-work, our art can be only tentative; and, even when we have selected the appropriate remedy, the precise mode in which it is to be applied can seldom be determined until several or even many doses of it have been administered. To do so with the greatest advantage implies the possession of a degree of therapeutical sagacity which is one of the rarest of natural gifts.

In many, indeed in most diseases, the condition which renders a certain dose of a medicine necessary at one stage having been palliated or removed, it is useless or injurious to continue the same dose. But when, and in what degree to modify it, is often a difficult question to decide. All medicines, it must further be borne in mind, create an artificial condition of the system, and, if they are repeated frequently, this condition, whether directly or indirectly produced, grows habitual, and may at last become a morbid state. Hence the necessity of generally augmenting the doses of medicines in order to produce their original effects. But if the susceptibility of the system to them becomes exhausted, as well as its original power of action, a state of torpor ensues which may involve serious consequences. When purgatives have been injudiciously employed to overcome habitual constipation, the bowels may at last cease altogether to respond to appropriate excitants. The case is still worse when a similar influence operates upon

the whole system. This is not unfrequently observed in typhoid conditions when stimulants to an exorbitant amount, or too often repeated, cease to produce a response, and the patients sink exhausted into a state of collapse. Amidst these and similar embarrassments the safest rule is to use no more of a medicine than is requisite to produce the effect which is intended, and to continue it no longer than is absolutely necessary. It cannot be too often repeated that every mere drug when used unnecessarily is mischievous.

CLASSIFICATION OF MEDICINES.

Many attempts have been made to form a scientific classification of the *Materia Medica*. The botanical, mineralogical, and chemical arrangements, although recommended by several eminent names, are totally useless to the physician; and the physiological, in consequence of its assuming as a basis of therapeutics, principles which are transient and uncertain, is only a delusive guide to the practitioner of medicine. Some writers have despaired of devising an arrangement or nomenclature at once rational and useful, and have taken refuge in an alphabetical catalogue of the articles of the *Materia Medica*. The sole merit of this plan is, that it facilitates research in works intended to be used rather for occasional reference than for systematic study. It is destitute of that suggestive power which belongs to natural classifications, and by which one article recalls others of the same nature that may be substituted for it with more or less advantage.

The most ancient, the most generally employed, and the most convenient classification of medicines is that of their arrangement in groups corresponding to their sensible operation upon the economy. The original foundation of practical medicine consisted in an attempt to promote the critical phenomena of diseases, or, where these did not appear, to imitate them. It was observed that they usually consisted of evacuations from the lungs, stomach, bowels, kidneys, skin, &c., and, as it became known by accident or by experiment, that certain substances occasion similar discharges, they were employed for this purpose in disease. In process of time, and with a more careful observation of the effects of medicines, it became evident that many of these latter which appeared to be simple, are in reality complex; that many medicines, analogous in their general effects, are yet dissimilar in their secondary or subordinate operations; that many which were regarded as acting upon individual organs, as a whole, in reality confine their operation to certain of their anatomical elements; that many natural

medicinal substances are composed of two or more active and sometimes discordant elements, &c. Such results of observation led, of necessity, to an extension of the original and natural classification, and to the formation of new classes, or a subdivision of the old. By some writers these subdivisions have been unduly multiplied and extended. A solicitude to provide shelter for remedies which might be claimed as fugitives from an older and more legitimate domicile appears to have induced this unnecessary multiplication of classes, and the invention for them of names which it is irksome to remember, and which are not always justified by ulterior experience. Undoubtedly the progress of physiological discovery has not only enabled us, but made it our duty, to discriminate between medicines which were once united under a common appellation. It is now believed that the nervous and the vascular systems, or the brain and the spinal marrow, may, to some extent, be influenced by certain medicines independently of one another, and it is therefore proper that such distinctions should be recognized in our classifications and nomenclatures.

In the arrangement proposed below, certain of these distinctions are observed, and an order of classes is adopted, the general plan of which is that it ascends from the simpler to the more complex forms of medication. At one of its extremities will be found emollients, the action of which is very simple, and for the most part mechanical; while at the opposite end of the ascending scale the class of alteratives is placed, whose mode of cure is totally inexplicable in the present state of our knowledge.

It will be found that the several classes do not always comprise the same articles which they include in other works. Many, if not all, medicines display diverse qualities according to their dose, combinations, mode, and time of administration, &c., but, as every one possesses some predominant virtue, on account of which it is most frequently prescribed, this circumstance has usually determined the author's choice of its position. In that place its subordinate as well as its cardinal qualities will be examined.

In presenting this arrangement of the *Materia Medica*, the author is not only aware that it is obnoxious to criticism, but he is quite alive to its numerous defects. While he has endeavored, in framing it, to avoid some of the errors which he believed to exist in other plans, he has become their debtor for the chief portion of whatever merit his own may possess.

CLASSIFICATION.

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| I. Medicines which allay local irritation. | LENITIVES. | |
| II. Medicines which repress local action. | ASTRINGENTS. | |
| III. Medicines that irritate the part to which
they are applied. | IRRITANTS. | |
| IV. Medicines which promote nutrition. | TONICS. | |
| V. Medicines which stimulate the whole
economy. | GENERAL STIMULANTS. | |
| VI. Medicines which stimulate the cerebro-
spinal system. | CEREBRO-SPINAL
STIMULANTS. | { Narcotics.
Antispasmodics. |
| VII. Medicines which especially stimulate the
spinal nervous system. | SPINANTS (<i>Tetanica</i>). | |
| VIII. Agents which depress the whole economy. | GENERAL SEDATIVES. | |
| IX. Medicines which depress the vascular
system. | ARTERIAL SEDATIVES. | |
| X. Medicines which depress the nervous
system. | NERVOUS SEDATIVES. | |
| XI. Medicines which produce a discharge from
particular organs. | EVACUANTS. | { Epispastics.
Errhines.
Sialagogues.
Emetics.
Cathartics.
Expectorants.
Diaphoretics.
Diuretics.
Emmenagogues.
Anthelmintics. |
| XII. Medicines which modify the nutrition of
the body, without producing any ante-
cedent phenomena. | ALTERATIVES. | |

CLASS I.

LENITIVES.

LENITIVES are medicines which, mainly by a local and mechanical action, allay irritation.

They owe this property chiefly to the gum, mucilage, starch, oil, fat, gelatin, or sugar which they contain, and, except in the case of oil and fat, to the solution of these substances in water.

Lenitives may be divided into Diluents, Emollients, and Demulcents.

Diluents comprise pure water and all aqueous solutions whose virtues chiefly depend upon this element.

Emollients are articles which tend to protect or to soften the tissues with which they come in contact on the surface of the body.

Demulcents are agents intended to exercise a like influence upon the mucous membrane of internal organs.

Emollients and Demulcents may be divided into four groups, the Mucilaginous, the Amylaceous, the Oleaginous, the Gelatinous, and the Saccharine. Each of these possesses qualities in some degree peculiar to itself, which will be pointed out in connection with the individual articles of the several groups. In this place we shall endeavor to describe the properties and uses of the class of Lenitives as a whole.

MODUS OPERANDI OF LENITIVES.

It seems not inappropriate to commence the study of the *Materia Medica* by examining a class of agents which are rather negative than positive in their medicinal operation, and which rather interpose themselves between morbid causes and the living organs than modify these latter, when diseased, by the exercise of any active virtues.

In all idiopathic fevers, an examination of the blood and of the secretions shows that there is retained within the system an undue

proportion of effete elements, which, in health, are discharged through the kidneys, the skin, and other emunctories, and it is probable that these elements not only interfere with the organic changes which belong to the healthy nutritive process, but act directly as irritants to the nerves, producing the numerous distressing sensations which accompany the diseases in question. By diluting the circulating fluid such symptoms are palliated, and the exhaustion which would result from their continuance is in some degree prevented. The same remarks apply to inflammatory affections, so far as in these the system at large sympathizes with the local disorder.

What is here presumed to be true of the operation of diluent lenitives upon the whole body in fevers, is more evident in regard to emollient and demulcent lenitives in the treatment of inflammatory diseases. Every local inflammation is aggravated, and in a great degree sustained, by its exposure to the action of many external agents, among which not the least irritating are light and atmospheric air. For as these elements, in the normal condition of the external organs, supply a stimulus which is essential to their proper development and nutrition, so, when the same organs have their activity abnormally excited, the continuance of the wonted stimulus adds fuel to the fire, and may urge the inflammatory process into disorganization. The simple exclusion of the irritant, on the other hand, may suffice to dissipate all suffering, and reduce the action of the inflamed part within the limits of a quick and easy cure. Thus, in the case of a burn of the first degree, the application of a mucilaginous, amylaceous, oily, or gelatinous substance is sufficient to produce this effect. But the variety of remedies which are thus equally successful proves that none of them exert a specific virtue, and the equal success of cotton wool or powdered starch or flour confirms this conclusion.

But it does not follow that the application of a dry substance which excludes the air will be equally soothing with a moist one. Experience shows that, except in very superficial inflammations, the former is less efficient than a protective substance which is also moist. By the imbibition of the liquid the inflamed parts become relaxed, and the pain, in so far as it depends on their tension, is relieved. This operation is greatly facilitated if, under certain circumstances, the moist application is also warm. Gentle warmth palliates almost every form of pain except that which is seated in the head. Hence the union of a lenitive emollient with moisture and warmth, in the shape of a cataplasm, has in all ages been a favorite remedy, and continues every day to render its unpretending services with signal efficacy.

There is no inflammation of the chest or abdomen, or of the deep-

seated parts of the extremities, which this homely application does not relieve. Whether it operates through the conducting power of the tissues intervening between itself and the seat of pain, or whether, as appears more probable, it acts by means of an impression upon the nerves, its soothing influence is as certain, and often as prompt, as the action of cold upon the surface of the body is in producing the inflammation of the organs beneath for which this remedy is employed. Care should be taken to keep all such applications in close contact with the skin, for otherwise they become cold and are more hurtful than useful. Nor should they, when composed of bread and milk, or linseed meal, &c., be too long applied, lest they unduly soften the skin, or irritate it even to the production of pustules. It has been proposed to substitute water contained in *spongio-piline*, lint, or other porous tissue for the emollient substances in common use; but these vehicles are more appropriate when cold and moisture are to be applied, as will be explained in its proper place. All of the applications referred to are constantly used as vehicles for the exhibition of stimulant, sedative, anodyne, and other medicines.

The substances in question also protect the parts to which they are applied from the action of irritating discharges, and are habitually employed for this purpose in the neighborhood of the various natural orifices of the body, and of wounds from which an acrid secretion flows. On account of their greater permanence, as well as their inferior miscibility with the secreted liquids, fatty substances are to be preferred.

The action last referred to is one of the most important of those exerted by lenitives which are administered internally. From the anatomical relations of the intestinal mucous membrane, all irritating agents are more apt to exert a prolonged action upon it than they do upon the skin when they are applied to this latter. These agents are numerous, and consist of ingesta which are either intrinsically irritant, or which become so during the changes which they undergo in the stomach and bowels; or else of the more or less altered secretions of the intestinal mucous membrane, or of the glands which pour their products upon it, and particularly of the liver, and perhaps, also, of the pancreas. When the sensibility of the mucous membrane is increased by inflammation, or otherwise, the secretions operate as irritants, and prolong and aggravate the disease. In like manner many acrid poisons are fatal from their concentrated form and the exposed state of the gastric mucous membrane. But lenitive medicines prevent or mitigate their effects, both by diluting the acrid agents, and by coating the mucous membrane with a protecting film. For this purpose, oily or albuminous substances are to be preferred in the case of irritant

poisons, and mucilaginous substances when the stomach is otherwise inflamed. They do not appear to undergo changes in the stomach to the same extent as the preparations chiefly composed of starch. These latter ought, however, under the circumstances supposed, to constitute the chief, if not the exclusive, food of the patient. A great advantage is their neutral taste, which enables them to be taken with less repugnance than articles which possess a definite savor, and which, according to the peculiarities of the patient, may be modified by the addition of saccharine or other more sapid substances without impairing their principal qualities. The action of lenitive medicines is well seen in their use as enemata, when the rectum is the seat of tenesmus produced by hemorrhoids, the inflammation of dysentery, &c. They often soothe the pain and calm the spasm, even when used alone, but they serve as convenient vehicles for other remedies of a more positive and active character.

But the continued use of this class of medicines is not unobjectionable. If they are employed after the morbid sensibility of the digestive organs has subsided, they tend to impair the power of these latter in performing even their natural functions, and to reduce them to a state of atony which may lay the foundation of serious disease. This condition is not unfrequently observed in acute diseases affecting other organs than those of the abdomen, when nutritious food having been too long withheld, amylaceous and mucilaginous articles undergo decomposition in the alimentary canal, distending it with flatus and causing heart-burn and acid eructations. One reason, doubtless, of this occurrence is, that the liver and other glands appropriated to the function of digestion no longer secrete in sufficient quantities the fluids which are essential to its due performance, and, instead of being converted into chyle, or preserved unchanged for expulsion from the body, the substances in question, undergo fermentative decomposition as they would elsewhere, under the influence of heat and moisture, distending the bowels with flatus, and sometimes occasioning diarrhoea.

Medicines of the lenitive class may also derange the stomach and bowels in other manners. Except in small quantities at a time, they generally produce, when given alone, an unpleasant impression upon the palate, and some degree of nausea, and, indeed, if copiously administered, do not fail to occasion both vomiting and relaxation of the bowels. These effects are sometimes induced with a curative intention, particularly when the irritability of the gastro-intestinal surface is such that medicines of the emetic and cathartic classes would be inadmissible. Preparations containing mucilage or starch are most frequently employed for this purpose, but the fatty oils have a similar

effect when given in large doses. It is undoubtedly by their bulk, in part, that such substances produce alvine evacuations, for they distend the bowel, and in this manner excite its peristaltic movements; but, being also relatively indigestible, they act as moderate irritants and provoke their own expulsion by stool. This is the case even with the simplest and mildest of all ingesta, water. A copious draught of it taken upon an empty stomach, is one of the very best means of procuring an alvine evacuation when torpor of the bowels depends upon their mere debility.

Of the substances belonging to the present class, certain of the constituents, viz., water, fat, albumen, and, perhaps, gum, are supposed to be absorbed from the alimentary canal without any change of composition; but sugar is converted into lactic acid, and starch into this latter and grape sugar. But as none of these substances appear unchanged, or during health, in the secretions, it is evident that they must be employed for the purposes of the economy. Nitrogenous substances (fibrin, albumen, casein, gluten) become incorporated with the organs, and are ultimately excreted in the bile or the urine. Carbonaceous matters (fat, sugar, gum, starch) are supposed to serve less as nutriment for the repair of wasted tissue, in general, than as sustainers of animal heat by means of their combustion with the oxygen absorbed during respiration. Hence these substances have been called *respiratory* by Liebig, and it is from them that the fat is derived, and held as a great reserve of carbonaceous matter in the system. None of them, however, possess the power of nourishing the body when given alone, and this is equally true of albumen, fibrin, and gelatin; while on the other hand, a combination of saccharine, oily, and nitrogenous substances with water, such as naturally exists in milk, affords the most perfect nutriment for the animal frame, especially during the earlier periods of its development. But, in proportion as the waste of the system is augmented by laborious exercise, as in adult life, the more highly nitrogenized forms of food are required to maintain the strength. If, when the habit of employing them is confirmed, the diet is changed to amylaceous substances, immediately the strength declines, and the tone of the digestive system is profoundly impaired; the muscles become flabby and feeble, the skin pale, the bloodvessels are less prominent, and the arterial pulsation is weaker. In like manner when, in the course of inflammatory affections, the activity of the circulatory system is morbidly increased, the use of lenitive medicines is an essential element of the cure.

The last remark refers particularly to all those preparations of which water forms a large proportion, and also to water itself, as has

already been pointed out. The symptom, thirst, which accompanies febrile affections, and sometimes reaches an intense degree, is a sufficient indication for the use of diluents, which, also, under these circumstances, are always preferred at a low temperature. In this way they not only dilute the blood and the secretions, and promote the latter, but actually cool the circulating fluids, assuaging the burning torments of fever, and calming the excitement of the nervous system. In those cases of a different class, in which the action of the organs and the molecular changes of the tissues are impeded by the spissitude of the blood, the administration of diluent drinks is followed by a sense of inexpressible relief. This is often witnessed after profuse hemorrhage, and during the exhausting serous discharges which characterize epidemic cholera.

Diluent lenitives are the appropriate adjuvants of all diuretic medicines, and, indeed, without them, the latter will seldom operate efficiently. In order to promote their absorption from the intestine, it should first be thoroughly emptied of its contents, for, besides removing a physical impediment, a cathartic probably renders absorption more active by its stimulant impression upon the mucous membrane. Although proof is wanting that emollient substances communicate their peculiar properties to the urine, independently of the water in which they are administered, there is, at least, a general belief that they do so, and one which few persons are willing to disregard in practice. The direct connection of the urinary bladder with the sexual organs in the male, and its close apposition and sympathy with them in the female, render the remedies in question often of signal benefit in the treatment of inflammation and irritation of the organs of generation. When the menstrual function is deranged by congestive affections of the uterus and ovaries, emollient and diluent remedies, both internally and locally, are frequently of signal service; and they are even more palpably so in urethral inflammations affecting the male.

MUCILAGINOUS LENITIVES.

ACACIA.—GUM ARABIC.

DESCRIPTION.—Gum Arabic is the concrete juice of *Acacia vera*, *A. Arabica*, *A. Senegal*, and many other species of *Acacia*, a thorny shrub, or small tree, which abounds in Northern Africa and in Arabia. The gum exudes spontaneously from the trunk and branches, and hardens on exposure to the air. The finer qualities, which are imported from Turkey, occur in rounded, pale yellowish lumps, or *tears*, transparent but traversed by fissures, brittle, inodorous, and of a slightly sweetish taste. Its powder is opaque and white. It is soluble in cold and in hot water, but not in alcohol, ether, or the oils. Its solution has an acid reaction, and gives a precipitate with a solution of the subacetate of lead. The proximate composition of gum Arabic is represented by soluble gum about 80, water 17, and various salts 3; it is ultimately resolvable into carbon 42, hydrogen 7, oxygen 51.

HISTORY.—Acacia is spoken of in the Hippocratic writings as an African or Egyptian tree, and Strabo mentions an acacia hedge surrounding the temple of Osiris, at Acanthus, in Egypt, whither the gum was brought. A similar hedge existed at Abydos, and was dedicated to Apollo. The leaves, flowers, and fruit were all used as astringent medicines, and even the gum is mentioned as a remedy for uterine hemorrhage.¹ Pliny in like manner speaks of the astringency of the plant, of its being used for tanning, and of the astringent and sedative properties of the gum, which, he says, is employed in affections of the eyes, for dyeing the hair, curing erysipelas, ulcers, contusions, prolapsus of the uterus and rectum, &c. &c.; in a word, it is treated of as an active astringent.² In this account Pliny follows Dioscorides³ and Theophrastus.⁴ It is impossible that these descriptions, and others corresponding to them by certain of the Arabian authors, should have reference to gum Arabic. As Matthiolus long ago said, "it is easy to perceive that gum Arabic is a very different thing from gum acacia." Of the accounts furnished by the Arabian authors, almost the only one that appears to have reference to that which we call gum Arabic,

¹ DIERBACH, *Arzneim. des Hippokrates*, p. 65.

² *Hist. Nat.*, xxiv. lxvii.

³ *Lib. i. cap. cxv.*

⁴ *Lib. iv. cap. iii.*

is given by Hobaisch, who says: "It restrains ordinary diarrhoeas, and furnishes a coating to the ulcerated bowel; it may be used to retain broken bones in apposition; it allays coughing when it is held and allowed to dissolve in the mouth, and may be associated with other medicines which have the same effect; it is useful in pulmonary inflammations or catarrhs, and in inflammations of the eyes; it may also be associated with purgative medicines to temper their acrimony."¹

ACTION AND USES.—Gum Arabic has generally been looked upon as a nutritious article of diet, and travellers have asserted that the Arabs in crossing the desert are in the habit of subsisting chiefly, if not exclusively, upon it. It is probable that the proportion of it which enters into their sustenance has been exaggerated, for the experiments of Magendie show that dogs fed exclusively upon this substance lose flesh rapidly and at last perish in a state of marasmus. Boussingault fed a duck with fifty grammes of gum Arabic and recovered forty-six from the excrements; and Frerichs, Blondlot, and Lehmann found that neither the saliva nor the gastric juice exercised any digestive effect upon it.² The accurate researches of Dr. Hammond also led him to conclude that "gum, so far from having any value as an alimentary substance, is positively injurious, owing to the fact of its clogging the intestines, and thus proving a cause of irritation. As an article of food for the sick, its use should be especially condemned."³ These experiments are exceedingly interesting, but they do not prove that gum when mixed with other food may not undergo changes which render it nutritive, nor should the experience of its utility in the treatment of inflammations of the stomach and bowels be lightly set aside by conclusions drawn from physiological experiments, however ingenious or however honestly performed. The loss of flesh and strength, the craving hunger, and the feverishness induced in a robust man by an exclusive diet of gum-water, are not sufficient reasons for rejecting it as the food of one who is already enfeebled by fever, and is utterly without desire for food.

As a medicine, gum Arabic has sometimes been used in powder to arrest bleeding from leech-bites, from the gums, &c., which it does by favoring coagulation, but it is chiefly employed to protect the mucous membranes from irritation. When the *fauces* are dry, and therefore irritable, a piece of the gum allowed to melt in the mouth excites the secretion of saliva, and, becoming dissolved in this fluid, forms a protective coating, and prevents the unpleasant sensation of dryness and

¹ EBN BAITHAR, ed. Sonthimer, ii. 133.

² W. A. HAMMOND, Prize Essay, Trans. Am. Med. Ass., x. 575.

³ Ibid., p. 584.

the tickling cough which it induces. In *gastro-intestinal irritations*, and still more in inflammations of the bowels, its solution is more soothing than water alone to the affected membrane, and probably more permanent in its influence. Combined with sugar in the form of a syrup, flavored with orange-flower water, and properly diluted, it is an agreeable and useful medicine or drink, in cases of slight bronchial inflammation.

ADMINISTRATION.—A solution is officinal called *Mucilage of Gum Arabic* (MUCILAGO ACACIÆ). In each fluidounce it contains half an ounce of the gum, and is generally prescribed in the proportion of one part to twelve in a mixture or emulsion. *Syrup of Acacia* (SYRUPUS ACACIÆ) prepared with gum, sugar, and water, is convenient for addition to mixtures, and may also, as above stated, be used when diluted with water, as a drink. Gum Arabic is used as the basis of nearly all the so-called pectoral gums and lozenges.

ALTHÆA.—MARSHMALLOW.

DESCRIPTION.—*Althæa officinalis* is an herbaceous perennial plant, several feet in height, with heart-shaped or ovate, downy leaves, and a long, tap-shaped, and fleshy root. It grows in moist and marshy places in Europe and in this country, but in the former is extensively cultivated for medicinal purposes. In Europe the root, flowers, and leaves of *Malva sylvestris*, *Malva rotundifolia*, and *Althæa rosa*, as well as of *Althæa officinalis*, are employed in medicine. Their qualities are not materially different. As found in commerce, marshmallow root is in fragments several inches in length, deprived of their epidermis, round or in split pieces, whitish, light, and brittle. When chewed it has a mucilaginous and sweetish taste. Its chief constituents are mucilage and starch, making about 73 per cent. of the whole; besides which it yields some sugar, phosphate of lime, and fatty oil. Cold water extracts its mucilage, but hot water its starch also. Besides these elements it contains a proximate principle called *althein*, which is crystallizable, odorless, and almost tasteless, and is soluble in water and dilute alcohol.

HISTORY.—Nothing can illustrate more perfectly the carelessness with which singular qualities are sometimes applied to medicinal substances, than the history of this simple plant. Its very name, according to Dioscorides, was given it in consequence of its numerous virtues, because it is resolvent and maturative, brings abscesses to a head, and cicatrizes them when voided. Its root, boiled in water or

wine, was applied as a pessary in uterine inflammations, and its decoction as an injection to promote the discharge of the placenta. Its juice, with wine, was esteemed diuretic, and useful in dysentery; with vinegar, as a remedy for toothache; oil in which its seeds had been cooked was a terror to serpents, and good for the dysentery, diarrhoea, spitting of blood, &c. &c.¹ Pliny, after enumerating these and similar statements, says: "Other marvels are told of mallows; but the greatest of all is that who ever will daily drink half a cupful of its juice will be exempt from all diseases." Still more marvellous is that which he himself declares to be ascertained, that the delivery of women in labor is hastened by mallow leaves strewn under the bed, and which, he adds, must be removed immediately after the delivery, for fear that the uterus should also be expelled. He also avers, on the authority of Xenocrates, that the seeds of a species of mallow in contact with the genital organs of women infinitely excite their venereal desires, and that three roots applied to the same part have a similar effect! With more truth he states that injections of mallow tea are very serviceable in tenesmus and dysentery, and that taken internally it relieves dysury.²

ACTION AND USES.—Marshmallow decoction is an emollient protective, and is somewhat nutritious, but when long and abundantly used it impairs the digestion. It is employed as a demulcent in all inflammatory and irritated conditions of the mucous membrane of the respiratory, digestive, and urinary organs, and poultices formed of the bruised or powdered root may be applied to local inflammations affecting the skin. The decoction has been used as an injection in dysentery and in inflammation of the uterus and vagina, and also to lessen rigidity of the soft parts in certain cases of difficult labor.

A preparation sold as *Marshmallow paste*, and a very agreeable demulcent, contains no marshmallow at all, but is made of gum Arabic, sugar, and white of eggs, and is flavored with orange-flower water.

CETRARIA.—ICELAND MOSS.

DESCRIPTION.—Cetraria, or *Iceland Moss* (*Lichen Islandicus*), is a cryptogamous plant of the natural order of lichens, which grows in rocky and mountainous situations, and most abundantly in the Alpine regions and northern countries of Europe and America. Its name is derived from the resemblance which its membranaceous and lobed frond or leaf bears to an ancient leather shield (καίτρεα). As found in

¹ Lib. iii. cap. cxlvi.

² Lib. xx. cap. lxxxiv.

commerce, cetraria consists of dry, leathery, crumpled leaves, which are of a brownish color, with occasional red spots upon the upper surface, and paler with whitish spots beneath. It is without odor, and has a bitter mucilaginous taste.

Cetraria imparts its virtues to boiling water, but by prolonged boiling its bitterness is impaired, and it loses its peculiar medicinal virtues. Its chief components are: 1. Amylaceous matter, *lichen-starch*, and *inulin*, 44 per cent. Of these two constituents, the former gives a blue, and the latter a yellow color, with iodine. Lichen starch differs from ordinary amylaceous matter in not being contained within separate cells or granules. It is extracted by boiling water, and, on cooling, acquires the consistence of a jelly. 2. *Cetrarin*, a bitter principle, 3 per cent. It is an acid, and may be removed from the plant by macerating it in a weak solution of carbonate of soda. The Icelanders, in preparing lichen for food, grind it into a coarse powder, and then by repeated washings deprive it of the greater part of its bitterness. Besides these constituents, lichen contains amylaceous fibrin 36.2 per cent., gum, sugar, yellow extractive, bitartrate of potash, tartrate and a trace of phosphate of lime, and a trace also of gallic acid.

HISTORY.—Iceland moss was brought into notice by Olaf Borrichius in 1674, and by Hiarne in 1683, as a medicine used by the inhabitants of Iceland in scurvy, hæmoptysis, and pulmonary disease with purulent expectoration, and also as an aliment when deprived of its bitterness by being cut into small pieces and steeped in water. Many physicians vaunted its qualities as so admirable that near the close of the last century Murray could say of it "*inter præstantissima igitur hodie medicamina splendet.*"¹ This general confidence in its virtues is ascribed to the influence of Scopoli, an Austro-Italian physician, who died in 1788.

ACTION.—Lichen is tonic, demulcent, and nutritious. The first named quality it owes exclusively to cetrarin, and the others to starch. The cetrarin is extracted by infusion as well as by decoction, but the starch by decoction only. The infusion on this account exhibits the action of a bitter tonic. It has a very bitter taste, increases the appetite, promotes digestion, and thus indirectly favors nutrition. It manifests no stimulant action upon the circulation, and does not occasion constipation of the bowels. Like other bitter tonics, in large doses, on the contrary, it causes diarrhoea, nausea, and oppression at the stomach. Deprived of its bitter principle, lichen does not differ materially in its action from other amylaceous preparations. It is said

¹ Apparat. Med., v. 499.

that the milk of nursing women becomes bitter when they make use of lichen.

USES.—Lichen was first used as a medicine by the Icelanders and Greenlanders in chronic pulmonary complaints. Linnæus also gave it the preference over all other substances of its class as an article of food for the consumptive; but Scopoli first brought it into general notice as a remedy for phthisis, which was then understood to include various forms of chronic bronchitis as well as tubercular consumption. In chronic bronchial affections with copious purulent or mucous expectoration, it was highly commended by Stoll. In these affections it was reputed to moderate the cough, render the breathing freer, appease the fever, correct the qualities of the sputa, increase the appetite, restore the digestive function, augment the muscular strength, repress colliquative perspiration and diarrhœa, and improve the nutrition, substituting fulness of flesh for emaciation. It was expressly stated to be useless, but not injurious in tuberculous phthisis.¹ So Reece, admitting the same distinction, says, the dietetic properties of lichen residing in a jelly or mucilage, it affords support to the debilitated frame of a phthisical patient; while the bitter principle, to a certain extent, is evidently of an anodyne or composing nature, allaying cough, and, unlike opium, at the same time facilitating expectoration, abating hectic fever, and quieting the whole system, without constipating the bowels. The bitter quality likewise possesses a peculiar tonic power, &c.² More recently, M. Clertan, of Dijon, states, that the absence of fever and pain are necessary conditions for the administration of this medicine, and that the cases in which it is most successful are those in which coughing is constantly provoked by a tickling in the trachea, and the sputa are viscid and transparent.³

Decoctions of lichen have been used in chronic affections of the *bowels*, particularly in those depending upon mere relaxation of the mucous membrane, and sometimes also in chronic dysentery without symptoms of active inflammation.

ADMINISTRATION.—If the tonic rather than the demulcent operation of the medicine is desired, an infusion of it is preferable to a decoction; but usually the combination of virtues obtained by moderate boiling is more desirable. The officinal decoction (DECOCTUM CETRARIÆ) is prepared by boiling half an ounce of Iceland moss in a pint and a half of water to a pint, and straining with compression. Of this, the dose is a pint, to be taken at intervals during the twenty-

¹ PAULISKY, Appar. Med., v. 514.

² A Treatise, &c., 2d ed., p. 3.

³ Bull. de Thérap., xliii. 182.

four hours. In order to correct its bitterness, it may be sweetened with honey or syrup. An infusion may be likewise prepared by steeping three ounces of the bruised plant in a pint and a half of boiling water for three hours, evaporating the liquor over a gentle heat to the consumption of one-half, and adding one drachm of extract of liquorice. Of this, three tablespoonfuls may be taken every three or four hours. It has sometimes been given in decoction with milk, which in some degree conceals its bitterness. This quality may be diminished, or, indeed, entirely removed, by macerating the lichen in an alkaline solution containing one part of caustic potash to three hundred parts of water, and then washing it with cold water.

CHONDRUS.—CARRAGEEN, or IRISH MOSS.

DESCRIPTION.—Carrageen consists of the flat, slender, cartilaginous frond of *chondrus crispus*, a plant of the natural family *Algæ*, which grows upon the western coast of Ireland, England, and the continent of Europe. When fresh, it is of a purplish color, but fades in drying, until it becomes yellowish or dirty white, except in small portions. It is tough, and, as it were, cartilaginous or horny, partially translucent, has a marine odor, and but little taste. It dissolves in boiling water, forming, when cold, a clear and colorless jelly, which is not unpleasant to the taste. It contains, according to Herberger, pectin, 79.1; mucus 9.5; resin 0.7; with fatty matter, free acids, phosphorus, alkaline earths, &c. Iodine, and, also, bromine, have been detected in carrageen. According to Herberger, the pectin of this plant, which Berzelius denominates *carragine*, is peculiar; differing from animal mucus on the one hand, and from vegetable mucus on the other.

HISTORY.—Carrageen has from time immemorial been used as food and medicine by the inhabitants of the west of Ireland. According to Pereira, it was introduced into medicine by Mr. Todhunter, of Dublin, in 1830. On the continent, attention was first drawn to it by Von Gräfe, in 1833.

ACTION AND USES.—Carrageen resembles Iceland moss deprived of its bitter principle. It is simply nutritious and demulcent; yet it has had an extensive reputation for efficiency in curing chronic pulmonary affections attended with discharges and cough; chronic intestinal fluxes; chronic affections of the urinary passages, &c. But there is no proof that it possesses any peculiar efficacy in these disorders.

A preparation which is highly nutritious, and has an agreeable odor and taste, may be made, according to the directions of Dr.

Frank, thus: Take of carrageen moss, macerated and washed, 3ss; spring water 3xvj; boil down to one-half, strain with expression, and add to the strained liquor, white sugar 3iv; gum Arabic, powdered, 3j; and powdered orris root 3ss; heat to dryness with a gentle temperature, stirring constantly so as to obtain a pulverulent mass, to which three ounces of arrowroot are to be added by trituration. A jelly is prepared with this powder, by rubbing a teaspoonful of it with a little cold water, and then pouring a cupful of boiling water on it. (*Neligan.*)

LINUM.—FLAXSEED. LINSEED.

DESCRIPTION.—Flaxseed is produced by *Linum usitatissimum*, or common flax, a plant which seems to have been cultivated first in Egypt, and is so now in every part of the world. It is an annual plant, with a slender root, smooth, erect stem, about a foot and a half high, and branched at the top. The leaves are alternate, lanceolate, and smooth, and the flowers blue and arranged in terminal corymbose panicles. The seed-pod is roundish, about the size of a pea, and contains ten seeds in distinct cells. The seeds are brownish and shining without, whitish within, about a line in length, and of a flattened oval shape. They have no smell, but an unpleasant, sweetish, oily, and mucilaginous taste. The husk contains an acrid soft resin, and the nucleus fatty oil, gum, mucilage, starch, albumen, gluten, &c. The mucilage is readily extracted by hot water, one part of the unbruised seeds rendering sixteen parts of boiling water mucilaginous. The oil is procured by expression. The ground seeds are known as *flaxseed meal*.

HISTORY.—Flax was known to the ancient Egyptians.¹ Hippocrates recommends flaxseed with the yolk of an egg in children's catarrh, in abdominal pains, diarrhoea, dysmenorrhoea, and leucorrhoea. He prescribes flaxseed cataplasms to be applied to the chest in inflammations of this region, and is careful to observe that the application must be warm, or else it will chill the patient. He more especially speaks of them as emollient remedies for inflamed and indurated parts.² Pliny furnishes a detailed account of the economical uses of flax, among which, having mentioned the manufacture of ropes and sails which carry men to perish at sea without the rites of burial, he exclaims: "No execration is strong enough against the inventor of

¹ Exodus ix. 31.

² DIERBACH, *Arzneim. des Hipp.*, p. 73.

such things."¹ Elsewhere he enumerates its medicinal qualities, as emollient, maturative, cleansing, soothing, and healing.² In this account, which he copies from Dioscorides, mention is also made of the frequent use of flaxseed to prepare enemata and vaginal injections. Arabian writers add very little of their own, but one, speaking of flaxseed enemata in dysentery, says that they are most efficient when prepared with oil.³

ACTION AND USES.—The union of oil and mucilage in flaxseed renders it peculiarly adapted for many external applications in which an emollient is required, and the facility with which its infusion is absorbed from the stomach has led to its being universally used to promote a diluent and diuretic action. In all inflammations whatever of the internal mucous membranes, flaxseed tea is habitually employed, but especially in those of the bronchia and urinary organs. In the former it serves as a vehicle for many mild expectorant remedies, and is the basis of numerous ptisans, containing ingredients like those of the compound decoction of barley. It also, as in ancient times, is a favorite form of enema, whether for the purpose of merely unloading the rectum of fæces, or of soothing the irritation in this organ produced by dysentery, hæmorrhoids, &c. For internal use, the *infusion* is generally made with half an ounce of the whole seeds to a pint of boiling water. It may be prescribed internally in any quantity. Externally it is often resorted to in cases of erysipelas, burns, &c., but it is apt to harden and render the skin very stiff and uncomfortable. In such cases acetate of lead is sometimes dissolved in it. The subacetate cannot be used in the same manner, as it undergoes precipitation.

The flaxseed poultice is the one most frequently employed in public, and perhaps, also, in private practice. It is prepared by pouring boiling water upon the meal, and stirring the mixture until it acquires a proper consistence. Before being applied to the skin, its surface should be slightly covered with sweet oil or other unctuous substance, or with glycerin, to prevent its adhering, and also to obviate the irritation which is otherwise apt to display itself in the form of a papular or pustular eruption. Flaxseed poultices have a greater tendency than others to render the skin white, wrinkled, and sodden.

MALVA—*Common Mallow*.—The herb of *Malva Sylvestris* is used in Europe for the same purposes as the leaves and root of *Althæa officinalis* (*vid. supra*). Common Mallow, and also *Malva rotundifolia*, are cultivated as garden plants in this country.

¹ Hist. Nat., xix. 1.

² Hist. Nat., xx. xcii.

³ EBN BAITHAR, i. 134.

SALEP.

DESCRIPTION.—Salep, which is not officinal in the Pharmacopœia of the United States, is the bulb of *Orchis mascula*, and other species of *Orchis*. It grows abundantly in Southern Europe, and is found even in England; but the Salep of commerce is chiefly brought from the Levant. Salep is in the form of rounded pieces, from the size of a cherry stone to that of an almond, of a grayish-yellow color, semi-transparent, hard, and horny, and of a slightly hircine odor when fresh. It is exceedingly difficult to pulverize, unless it is first softened by being soaked in water. Its taste is mucilaginous and slightly saline. Guibourt, who analyzed the recent bulb, found it to consist chiefly of starch slightly soluble in boiling water, but swelling in it so as to form an abundant and tenacious jelly of mucilage and calcareous salts. C. Schmidt obtained similar results.

HISTORY.—This plant, or rather the genus to which it belongs, was called *orchis*, or cynos-orchis (dog's testicle) by the Greeks, on account of the shape of its bulbs. Dioscorides refers to the popular belief that if men eat the larger bulb it causes them to engender males, and that if women eat the smaller they conceive females; he likewise alludes to the notion that the former excites, while the latter restrains the venereal passion. He also mentions that cataplasms are made of the bulbs for ulcers, abscesses, &c., and that they are very nutritious as food.¹ The same author describes very correctly the peculiar apposition of the bulbs, when he says they lie together like two olives, of which the one is full and succulent, but the other dry and wrinkled. In truth, as is now well known, the former is the new and growing bulb, but the latter the old and withered. Floyer calls this plant *Male Fools-Stones*, and says that the rank smell of the bulb shows some venereal virtue.² Culpepper, also, like Dioscorides, attributes contrary virtues to the two bulbs, adding, "these alter every year by course, when the one riseth and waxeth full, the other waxeth lank and perisheth."³ The Arabian physicians prescribe salep with great confidence in consumption; the Indian practitioners believe it to be a powerful strengthener of the body; and by the Egyptians it is considered as a medicine possessing great invigorating virtues.⁴

ACTION AND USES.—Salep is demulcent and nutritious, and tends rather to confine than to relax the bowels. The notion of its possessing aphrodisiac virtues was evidently suggested by the arrangement of its

¹ Mat. Med., lib. iii., cap. cxxiv.

³ HERBAL.

² TOUCHSTONE, &c., p. 159.

⁴ AINSLIE, Med. Ind., i. 368.

bulbs and the absurd doctrine of signatures. Of amylaceous substances there is none superior to salep as food for those who are disposed to intestinal relaxation, and hence it forms one of the most useful articles of diet for infants and children affected with summer complaint or diarrhoea. In chronic dysenteric affections, and in the diarrhoea dependent upon tuberculous ulceration of the bowels, it is one of the best articles of diet that can be employed. The mucilage is prepared by first macerating powdered salep in cold water, and gradually adding boiling water, with stirring, in the proportion of five grains to the ounce of water. Or, instead of water, milk or some animal broth may be used, and flavored or seasoned according to circumstances. Salep *jelly* is made as follows: Rub one drachm of salep with water in a mortar until it has swollen to four times its original bulk, then add gradually, and with constant stirring, sixteen ounces of boiling water, and boil down to eight ounces.

SASSAFRAS MEDULLA.—SASSAFRAS PITH.

DESCRIPTION.—The pith of the stems of *Sassafras officinale* is in whitish, semi-cylindrical pieces, very light and spongy, and of a somewhat camphoraceous taste. With cold water it forms a transparent, ropy mucilage, which has slight adhesive qualities, and is not, like mucilage of gum Arabic, rendered turbid by alcohol.

ACTION AND USES.—The mucilage of sassafras pith is demulcent, and at the same time a very mild local stimulant. It may be used for all the purposes, both internal and external, to which the mucilages are applied. It is most commonly employed as a collyrium, in acute conjunctivitis, either alone, or as a vehicle for other and more active remedies. It is equally appropriate as a soothing application in erythematous and other inflammations of the skin. Internally, this mucilage may be given freely as a drink in dysentery and other bowel complaints, and in febrile affections generally.

SESAMI FOLIA.—BENNE LEAVES.

OLEUM SESAMI.—Benne Oil.

DESCRIPTION.—*Sesamum Indicum* and *Sesamum Orientale*, which are the officinal sources of Benne, are natives of India, but now abundant in all Asia, Egypt, and Italy. The first named species is said to be

that which is cultivated in South Carolina (whither it was brought from Africa by the negroes), and also in the neighborhood of Philadelphia. Sesame is an annual plant, four or five feet high, with a pubescent stem, ovate-lanceolate and lobed leaves, reddish-white axillary flowers, and an oblong capsule containing small, oval, yellowish seeds. The seeds furnish abundantly a fixed oil, and the leaves yield to cold water a large quantity of rich, bland mucus, closely resembling that of sassafras pith. Mr. Hubbell, a pharmacist of Philadelphia, by precipitating the mucilaginous principle with alcohol, and drying it, has prepared an extract, which he calls "Sesame, or Benne-Leaf Gum," and which, on being dissolved in water, reproduces the mucus in nearly the same condition as when fresh.

HISTORY.—Sesame was anciently ranked among the most nutritious grains. Hippocrates recommended consumptive persons to use bread made of it instead of wheaten bread, and in pulmonary catarrhs he prescribed an emulsion made with sesame, almonds, and melon seeds. To this day sesame is employed to make bread throughout oriental countries, and even westward to the Levant. In Hindostan the natives use the expressed oil of the seeds for the same purposes for which we employ olive oil, and also as a medicine. Ainslie says that it is considered by some native practitioners to possess emmenagogue virtues, and to be capable, if taken incautiously, of producing abortion.

USES.—The seeds of sesame are used by the negroes of South Carolina in making broths, and are also eaten parched. The oil is more bland than olive oil, and may be applied to the same purposes. The mucus is generally prepared from the fresh leaves by infusing them in cold water. It is much esteemed as a demulcent drink in cholera infantum, and other disorders of the bowels in children. Doubtless it is applicable to the same cases as other mucuses, both internally and externally, and in the former mode has the advantage of an agreeable taste.

TRAGACANTHA.—TRAGACANTH.

DESCRIPTION.—Tragacanth is defined to be "the concrete juice of *Astragalus verus*," but it is the product of many species of astragalus. This is a small prickly shrub, covered with pointed imbricated scales, which grows wild in many parts of Asia Minor. The gum exudes from the lower part of the stem through natural fissures in the bark, or through punctures made with a knife. In the former case it assumes the shape of tortuous vermiform filaments, and, in the other, of flatter pieces with concentric elevations.

Tragacanth is inodorous and insipid, very hard, and, owing to its strong attraction for water, difficult to pulverize unless thoroughly dried and pounded in a heated mortar. When added to water it does not readily dissolve, but forms a very tenacious paste, and, with a larger proportion of water, a very thick mucilage. According to Bucholz, it is composed of common gum (arabin) 57 per cent., and bassorin, or insoluble gum, 43 per cent.; but Guibourt maintains that gum tragacanth contains neither arabin nor bassorin, but is mainly composed of an organized gelatinous substance, which swells and divides in water, so as only partially to traverse a filter, and which greatly differs in its physical and chemical properties from gum Arabic. The portion which is insoluble even in boiling water is, according to the same authority, a mixture of starch and woody fibre.¹

HISTORY.—Tragacanth was well known to the ancients. Dioscorides describes it as a concrete juice obtained by incisions made in the root of a tree, and says that it is associated with other medicines for the eyes, for cough, dryness of the throat, for a cracked and hoarse voice, &c. He adds it is used for making electuaries or lozenges which are allowed to dissolve in the mouth.² Galen gives a similar account, adding that it moderates the activity of heating or irritating medicines. The same remark is repeated by the Arabians, who insist upon its virtues in promoting expectoration and allaying irritation of the lungs, and recommend it as an emollient and soothing application to inflamed parts.³

ACTION AND USES.—Tragacanth is demulcent and nutritious, but, owing to the difficulty of dissolving it, is seldom used medicinally except as a vehicle for medicines that are not soluble in water, as camphor, and as an excipient in troches and lozenges, which are intended to dissolve slowly in the mouth. On account of its tenacity, the mucilage of tragacanth (MUCILAGO TRAGACANTHÆ) has sometimes been used as a protective application to burns.

ULMUS.—SLIPPERY ELM BARK.

DESCRIPTION.—This is the inner bark of *Ulmus fulva*, the slippery or red elm, a tall native tree of North America, growing most abundantly west of the Alleghany Mountains. The outer bark is rough, brownish on the trunk and whitish on the limbs. The inner bark, as

¹ Hist. des Drogues, 4ème éd., iii. 418.

² Mat. Med., lib. iii. cap. xx.

³ EBN BAITHAR, op. cit., ii. 350.

brought into commerce, is in long flat pieces, of a tawny color, folded on themselves, readily torn into long fibres, of a somewhat sweetish smell and taste, and very mucilaginous when chewed. It is also ground into a coarse light powder of a grayish-yellow color. It yields its mueilage abundantly to cold, and still more so to hot water, and precipitates the acetates of lead from their solutions. No sufficient analysis of this bark has been published.

ACTION AND USES.—Undoubtedly the principal action of slippery elm bark is due to its abundant mueilage, in virtue of which it is demulcent in a high degree. But that it contains another peculiar principle is shown by its power of preserving fatty substances from rancidity. This power was well known to the aborigines, who prepared bear's fat by heating it with the bark. Dr. Wright, of Cincinnati, found this method of preserving butter and lard successful.¹

As a demulcent, the mueilage of slippery elm bark (*INFUSUM ULMI*) is constantly used in all acute affections of the respiratory, digestive, and urinary organs. It is grateful to the taste, and does not readily disorder the stomach. To some extent, also, it is nutritious. The American Indians employed it internally for the cure of some cutaneous diseases, and Dr. Griffith says that from witnessing its effects in some extremely obstinate cases of herpetic and syphilitic eruptions, he was inclined to attribute to it higher curative powers than are usually admitted.² The inner bark of the European elm (*U. campestris*) has long been celebrated as a remedy in such disorders,³ but besides mueilage, which it contains in less quantity than the American species, it has a bitter and astringent taste.

For external application, the mueilage and the powdered bark are in general and constant use. The former is frequently applied to erysipelatous and other acute eruptions of the skin, and the latter, as a poultice, to abscesses, inflamed joints, &c. An objection to both, however, is that they, and especially the former, harden upon the skin and render it stiff and uncomfortable. When poultices of slippery elm are used, they should be prevented from drying by being covered with oiled silk, gum elastic, gutta percha, or some other impermeable material.

In 1837, Dr. McDowell, of Virginia, proposed the use of slippery elm bark to dilate strictures of the urethra, fistulas, &c., but it was found that the liability of the bark to fracture rendered it an ineligible instrument. Dr. H. R. Storer, of Boston, acting upon the original

¹ U. S. Dispensatory.

² Med. Botany, p. 563.

³ Mem. Lond. Coll. Phys., ii. 193.

suggestion, applied slippery elm bark to the manufacture of tents for dilating the neck of the uterus in cases of disease within that organ. By disintegrating the fibres from each other, a mass of flexible, tough, spongy tissue was obtained, readily moulded into the shape of a tent, endowed with a less degree of expansibility than sponge, and on that account, according to Dr. S., more safe in the using. It is also free from the liability of producing an offensive smell, as sponge does, while the mucilage it yields acts favorably upon the distended parts.¹

AMYLUM.—WHEAT STARCH.

DESCRIPTION.—Starch is a proximate principle constituting a large portion of the vegetable food consumed by animals. It is prepared for medicinal purposes by washing coarsely-bruised wheat repeatedly with cold water, which dissolves out the starch, and then separating the latter by draining off the water. When dried and prepared for sale, starch is in irregular or columnar white masses, light, brittle, and readily pulverized. It dissolves in boiling water, and forms with it on cooling, an opalescent semi-transparent jelly or thick liquid. It forms with iodine a blue compound, and hence it becomes the most delicate and certain test of the presence of iodine in solution.

HISTORY.—Dioscorides² and Pliny³ both describe a process for preparing starch, which is almost identical with that used at the present day, and the former mentions it as a demulcent application to inflamed eyes, and to ulcers, and says that internally, it is useful in hæmoptysis and for dryness of the throat. He adds that it is made into porridge with milk, and is used in the culinary art. Both of the above authors derive amyllum from *à priv.* and *μύλη*, mill, because it is a flour made without a mill.

ACTION AND USES.—Starch is used in solution as a demulcent to protect irritated surfaces, but chiefly as an emollient enema in dysentery, or to serve as a vehicle for introducing narcotic or other substances into the economy. Bandages saturated with starch have been employed in the treatment of fractures as a substitute for splints. Powdered starch is extensively used to dust the skin of infants and delicate females, where it is exposed to attrition, or to absorb the moisture which renders it liable to become irritated. Starch mixed with water is the best antidote to the caustic action of iodine upon the alimentary canal, as it forms a bland compound with this substance.

¹ Bost. Med. and Surg. Journ., Nov., 1855, p. 297.

² Lib. ii. cap. xciv.

³ Hist. Nat., lib. xviii. cap. xvii.

AMYLACEOUS LENITIVES.

AVENÆ FARINA.—OATMEAL.

DESCRIPTION.—Oatmeal is prepared from the seeds of *Avena sativa*. According to Christison's analysis, it contains 72.8 per cent. of starch; 5.8 of saccharo-mucilaginous extract; 3.2 of albumen; and 11.3 of lignin or bran.

HISTORY.—Pliny says that the Germans used oatmeal porridge as food,¹ that, like barley and other grains, it is made into poultices, and that its decoction is good for a cough.² Dioscorides and Galen make similar statements, but the latter adds that although it is fitter food for beast than man, yet in times of famine it is used by the latter. In modern times the Scotch peasantry, like the ancient Germans, depend upon it mainly for sustenance.

ACTION AND USES.—On chemical grounds, and from experience, oatmeal must be regarded as very nutritious, but when used as an exclusive diet for a length of time, it is apt to cause acidity of the stomach. The prevalence of pyrosis and gastrodynia amongst those who subsist upon it is well known.

In medicine it is chiefly used as a diet for the sick, made into a thin mixture with water (gruel), and is more nutritious than the purely amylaceous substances, as sago, arrowroot, &c. It is one of the best articles of food that can be taken by those who suffer from constipation depending upon inertia of the bowels produced by sedentary habits. Like all alimentary substances which contain an unassimilable element, oatmeal when long used as an exclusive diet, is apt to leave its bran in the bowels, where, by gradual accumulations, it may form large concretions.

Oatmeal gruel or *porridge* is prepared by boiling from one to two ounces of the meal with three pints of water to a quart, straining the decoction, allowing it to stand till it cools, and then pouring off the clear liquor from the sediment. Dr. A. T. Thompson gives the following directions for preparing *Flummery* or *Sowens*: "Take a quart or any quantity of groats, or of oatmeal; rub the groats or the meal for a considerable time with two quarts of hot water, and leave the

¹ Lib. xviii. cap. xlv.

² Lib. xxii. cap. lxxix.

mixture for several days at rest, in an earthen vessel, until it becomes sour; then add another quart of hot water, and strain through a hair sieve. Leave the strained fluid at rest until it deposits a white sediment, which is the starch of the oats; lastly, pour off the supernatant water, and wash the sediment with cold water. The washed sediment may be either boiled with fresh water, stirring the whole time it is boiling, until it forms a mucilage or jelly, or it may be dried, and afterwards prepared in the same manner as arrowroot mucilage. It may be eaten with milk or wine, or lemon-juice and sugar."

HORDEUM.—PEARL BARLEY.

DESCRIPTION.—Barley is the grain of *Hordeum vulgare* and *H. distichon*. It has been found growing wild in both hemispheres. The cultivated plant is too well known to require description. According to Einhoff, barley contains about 67 per cent. of starch, besides sugar, gum, gluten, &c.; but Proust found in it 32 or 33 per cent. only of starch, and 57 or 58 per cent. of *hordein*, a substance which differs from starch in not forming a paste with hot water. Pearl barley is the seed deprived of its investment, by which means it is reduced to an almost pure starch. For medicinal purposes barley is chiefly used in *decoction* (DECOCTUM HORDEI), which is prepared by boiling for a short time, two ounces of well washed pearl barley in half a pint of water, which is then thrown away, and four pints of boiling water are added. The whole is boiled down to two pints and strained. If to the simple decoction, thus prepared, are added two ounces and a half of figs, five drachms of bruised liquorice root, two ounces and a half of stoned raisins, and a pint of water, and the mixture is boiled down to two pints and strained, we have a compound decoction (*Lond.*) of agreeable taste and useful qualities, as being both laxative and demulcent.

HISTORY.—Barley is repeatedly mentioned in the books of the Old Testament, and first as among the things that were destroyed by the plagues of Egypt.¹ In the Hippocratic writings it is named more frequently than almost any other substance used in medicine. With its husk it was regarded as laxative, but when deprived of this investment, as tending to confine the bowels. It was used to make poul-tices, but chiefly to form ptisans; indeed we are assured that the word *ptisan* standing alone, always signified barley water. It was prepared so as to be used either with the barley in it, or deprived of this by

¹ Exodus ix. 31.

straining through a sieve. It was held to be the best of all articles in febrile affections, both as food and drink, on account of its mucilaginous consistence, its digestibility, and its agreeable taste, and because it does not produce thirst or flatulence. Barley water with honey was constantly used in pulmonary affections.¹ Dioscorides says that barley is detergent, and, contrary to the statement of Hippocrates, that it is flatulent and injurious to the stomach, but in this latter opinion he is also opposed to Galen. Dioscorides dilates upon the advantages of cataplasms made of barley meal and applied to abscesses, and other inflammations of external parts,² and Pliny describes in detail a number of such applications rendered more active by narcotic, stimulant, or astringent ingredients.³ The Arabians add nothing to these accounts, except that they recommend barley water as a gargle in sore throat.⁴

USES.—The simple decoction of barley water is the usual drink prescribed in all febrile affections, and particularly in those of the pulmonary, digestive, and urinary organs. It is more appropriate than rice water when there is no tendency to diarrhoea, and is presumed to have a more soothing action upon the inflamed or irritated mucous membranes. In bronchial affections it will be found useful to employ the compound rather than the simple decoction, or to use this latter sweetened with honey. The same preparation may be used as a gargle in sore throat with or without the addition of lemon-juice or other acid, either vegetable or mineral.

MARANTA.—ARROWROOT.

DESCRIPTION.—Arrowroot is a form of starch derived from the rhizome of *Maranta arundinacea* and other species of *Maranta* cultivated in the West Indies, and the extreme southern parts of the United States, the East Indies, the Mauritius, and Southern Africa, to which places it was transplanted from the West Indies. The most esteemed is brought from Bermuda. The rhizome is elongated, horizontal, articulated, fleshy, and white. Besides 65 per cent. of water, it yields 26 per cent. of starch, which is obtained by reducing the rhizome to a pulp, mixing it with water, passing it through a sieve to remove the impurities, draining off the water, and drying the fecula in the sun. As found in the shops, Bermuda arrowroot is a snow-white powder,

¹ DIERBACH, *Arzneim. des Hippokrat.*, p. 9.

² *Mat. Med.*, lib. ii. cap. lxxix.

³ *Hist. Nat.*, lib. xxii. cap. lxxviii.

⁴ EBN BAITHAR, ii. 97.

intermixed with small, irregular masses of fecula, somewhat gritty under pressure, and of a sweetish taste as it dissolves in the saliva.

HISTORY.—“This plant was brought from the island of Dominica by Colonel James Walker, to Barbadoes, and there planted. From thence it was sent to Jamaica. That gentleman observed that the native Indians used the root against the poison of their arrows by mashing and applying it to the poisoned wounds. The valuable properties of the starch made from the root are mentioned by Hughes in 1751, and the mode of preparing it described by Browne in 1789.” (*Pereira*.)

ACTION AND USES.—As the purest natural form of starch, arrowroot is nutritious and demulcent. It is entirely devoid of irritant properties, in which respect it differs materially from potato starch, which is frequently sold under its name. On this account it constitutes a very excellent article of diet for the sick in all febrile affections, and especially in disorders of the stomach and bowels. It is superior to all other articles of the amylaceous class as food for infants at weaning, or when milk alone proves indigestible. It is prepared by mixing a tablespoonful of arrowroot with a little cold water until it is reduced to a paste, and then gradually adding a pint of boiling water or milk, or due proportions of each, stirring the mixture at the same time. It may then be sweetened. Cream is sometimes added to the watery solution in cases of irritability of the stomach or bowels. In low forms of disease a little wine or spices may also be used with the watery preparation of arrowroot.

Other varieties of fecula resembling the above are used medicinally. The purest of these is *Tous-les-mois*, obtained from a tuberous root of the West Indies (*canna cocinea*, Guibourt). Purified *potato starch* answers for ordinary purposes as food, but, as remarked, not when the stomach and bowels are irritable.

ORYZA.—RICE.

DESCRIPTION.—The fruit of *Oryza Sativa*, a native plant of the East Indies, but now cultivated in many parts of the western world, but especially in the United States and in Italy. It contains about 85 per cent. of starch, and nearly 4 per cent. of gluten, and cannot be considered as nutritious as wheat.

HISTORY.—Rice was known to Celsus, Pliny, Dioscorides, and Galen, who all agree in ascribing to it nutritive qualities, and in stating that it tends to confine the bowels, and hence is appropriate in relaxation of these parts. The Arabians speak of the peculiar efficacy of rice-

water in colic and dysentery, when given by the mouth and also as an enema. They further allude to its universal use by the Orientals as food.

USES.—Rice, it is well known, forms the almost exclusive food of millions of the human race, yet it has been doubted whether it is fitted of itself to support life! When properly boiled it forms an excellent diet for the sick, and its decoction, or rice water, is peculiarly adapted to affections accompanied with looseness of the bowels. Rice water is made by boiling two ounces of rice in two quarts of water, for an hour and a half, and sweetening or flavoring it according to circumstances.

SAGO.—SAGO.

DESCRIPTION.—Sago is the prepared fecula of *Sagus Rumphii*, and other trees of the palm tribe, growing in the East Indies, and especially the islands of the Indian Archipelago. It is obtained by mixing with water finely broken pieces of the stem of the tree, by which the fecula is extracted. It is then separated by straining from the woody fragments, and the water is evaporated leaving the fecula behind. It is afterwards prepared with much skill, and brought into commerce in the form of small, whitish, or pinkish spherical grains, which become transparent in hot water, and ultimately, although not readily, dissolve in it. Sago is probably composed almost entirely of starch, but we are not acquainted with any analysis of it.

HISTORY.—The earliest account of sago was given by Marco Polo in the thirteenth century, but it was more accurately described by Clusius in the sixteenth. Granulated sago was first taken to Europe in 1729.¹

USES.—Sago is demulcent and nutritious, and is admirably adapted to be used as food for the sick whenever the digestive organs are feeble, or the existence of fever calls for nourishment without stimulus. It is generally more acceptable to the palate than arrowroot or tapioca, and is more digestible than rice.

TAPIOCA.—TAPIOCA.

DESCRIPTION.—Tapioca is the fecula of the root of *Jatropha Manihot*, or cassava, a native shrub of the West Indies and Brazil, although Raynal states that it was originally brought from Africa by the negroes.²

¹ STRUMPF, Handbuch, i. 39.

² Diet. de Mat. Méd., iii. 677.

The root is a large tuber abounding in a milky juice. It is reduced to a pulp and subjected to pressure, dried and ground, and its volatile and poisonous part having been dissipated by heat, it is used to make bread, puddings, &c. The expressed juice contains a large proportion of fecula, which subsides, on standing, and then, after being well washed with water, is dried in the sun or by artificial heat, and forms the tapioca of commerce.

Tapioca consists of rough, irregular, whitish masses, from the size of a grain of mustard seed to that of a cherry-stone. It is hard, tough, has but little taste, is slightly soluble in cold water, and forms with boiling water a transparent, viscid, and tremulous jelly. When the starch is dried without heat, it constitutes the *cassava starch* or *Brazilian arrowroot* of commerce. It closely resembles genuine arrowroot in external appearance.

Tapioca, it has been stated, is associated in the root of the plant from which it is derived, with a poisonous juice. The noxious principle is extremely volatile, and is dissipated by heat or even by the exposure of the juice to the air for thirty-six hours. It has been obtained by distillation. Half a teaspoonful destroyed a dog in less than five minutes; and a slave condemned to death was killed in as short a time by thirty-five drops of the liquid.¹ In 1796, Dr. Clark, of Dominica, described its sudden and fatal effects upon man and beast, comparing them with those of prussic acid. He mentions as the principal symptoms produced, spasmodic constriction of the throat, convulsions, coma, and death, with dilated pupils.² This union of a deadly poison with a highly nutritive substance is met with in the case of bitter almonds and some other fruits, and most frequently the poison is found to be prussic acid or a substance convertible into it (amygdalin?) by the operation of the stomach. MM. Henry and Boutron-Charlard, however, found free hydrocyanic acid in the bitter cassava root.³

HISTORY.—Tapioca was described by Piso, in the middle of the 17th century, under the title *Radix Mandihoca*.⁴ This author mentions the demulcent and nutritive qualities of the starch, and the poisonous nature of the juice of the root. The same peculiarity is noticed by Petrus Martyr.⁵

USES.—Tapioca is chiefly used as food for infants and for the sick. Dr. Christison says: "No amylaceous substance is so much relished by infants about the time of weaning; and in them it is less apt to become

¹ Dict. de Mat. Méd., iii. 677.

² Med. Facts and Obs., vii. 289.

³ Mém. de l'Acad. de Méd., v. 212.

⁴ De Indiæ utriusque re naturali, &c., p. 114.

⁵ SPRENGEL, Hist. Rei. Herb., ii. 370.

sour during digestion than any other farinaceous food, even arrowroot not excepted." Mucilage of tapioca may be made as follows: Take a tablespoonful of tapioca, macerate it in a pint of warm water for an hour, and then boil it for ten minutes, stirring all the time. Sugar may then be added, with lemon-juice, or currant jelly, nutmeg, wine, &c., to give it a flavor, neutralize its somewhat pasty taste, and adapt it to the condition of the patient.

FATTY AND OLEAGINOUS LENITIVES.

ADEPS.—LARD.

DESCRIPTION.—Lard is the prepared fat of the hog (*Sus Scrofa*). It is separated by means of heat and water from the blood, cellular tissue, and other impurities mixed with it. When pure, lard is a white, granular, unctuous soft solid, of faint taste and smell. It is insoluble in water, but is partially soluble in alcohol and in ether. According to Braconnot, it is composed of 62 per cent. of olein and 38 per cent. of margarin and stearin. It speedily becomes rancid by keeping, and to prevent this change it is usually mixed with salt. When employed for medical purposes, this addition must be removed by melting the lard in water, agitating it so as to abstract all the salt, and then cooling it until the pure lard concretes on the surface of the liquid. The addition of benzoin to lard prevents it from becoming rancid.

HISTORY.—Pliny¹ mentions as the etymology of *axungia*, the Latin word for lard, *axis*, axle, and *ungere*, to anoint, because the ancients made use of lard to grease the axles of their carriages. He speaks also of fresh and salted lard, and of its use as an emollient, warming, resolvent, and detergent remedy; of the value of fresh lard as a dressing for burns, frost-bite, and abrasions, and of inunctions with it to relieve muscular fatigue. He refers particularly to its internal administration for the cure of phthisis, when it is boiled with old wine, from which it is evident that the present treatment of the disease by oily substances is not new. Celsus says, "It is necessary for the body to be anointed, and gently rubbed even in acute and recent distempers."² Dioscorides³ describes at great length the mode of preparing

¹ Hist. Nat., xxxiii. 272.

² Book ii. chap. xiv.

³ Mat. Med., lib. ii. cap. lxix.

lard and other animal fats for medicinal purposes; and Galen is equally copious in detailing the medicinal uses of each of them. He states that lard is the most emollient of them all, and the most appropriate excipient in making all kinds of ointments, while olive oil is more stimulating or heating. It may not be uninteresting to notice that of bear's grease, he says, "Even were it true, as some maintain, that it is a cure for baldness, yet we possess far more efficient remedies for this affection."

ACTION AND USES.—Lard is familiarly known as an article of food, and is extensively employed in the culinary art. It is with difficulty digested by delicate stomachs, and should never be used without a large admixture of some farinaceous article.

As a medicine it is seldom administered internally, except among the vulgar as a laxative in infantile cases of bowel complaint. Externally it is in constant use, but less on account of its own virtues than because it is the usual excipient of medicinal substances which are to be applied in the form of ointment. After the example of the ancients, it has been employed and highly recommended (1837) by Wolters, a German physician, as a remedy for phthisis. This person prescribed repeated and prolonged frictions of the back and breast of consumptive patients with a piece of the subcutaneous fat of pork still attached to the integument. More recently (1848) Dr. Schneeman, of Hanover, proposed this treatment in scarlet fever, alleging that it not only relieved the burning and itching of the skin, but also modified the affection of the throat, and protected against the sequelæ of the disease.¹ It was employed extensively by Mauthner, of Vienna, and received his commendation; and Dr. J. F. Meigs has found that the less offensive application of glycerin and cold cream has the effect of lowering the pulse, alleviating the external heat, dryness, itching, and irritation, and diminishing the injurious effects of the disease upon the constitution at large.² From what we have observed, these effects are unquestionable, and afford a sufficient ground for employing the remedy; but we have seen no evidence of its being successful in cases which would not otherwise have recovered.

Mauthner, Schneeman, and others also employed inunctions of lard in measles, and with more favorable results, it is said, than are obtained by the method in common use.³

In scarlet fever the inunctions should be applied twice a day or oftener, according to the heat of the skin, and as much as possible

¹ *Lancet*, Sept., 1849.

² *Diseases of Children*, 2d ed., p. 523.

³ *Bull. de Thérap.*, lv. 141.

over the whole surface of the body. The operation is, however, sometimes found annoying, and, after having been several times repeated, the bed linen becomes so much soiled that, unless the inunction appears necessary, a repugnance is felt, on the part of the attendants as well as of the patient, to its being continued.

AMYGDALA AMARA.—BITTER ALMONDS.

AMYGDALA DULCIS.—*Sweet Almonds.*

DESCRIPTION.—Almonds are the seeds of *Amygdalus communis*, a tree which is a native of Asia Minor and Africa, and is cultivated in the South of Europe and partially in the southern portions of the United States. It is usually fifteen or twenty feet in height, with spreading branches, and bears numerous white or pinkish flowers. The fruit is a drupe with rather a membranous than a fleshy covering, which, when ripe, opens and exposes a shell within which is the kernel. According to the qualities of this latter, almonds are divided into *sweet* and *bitter*.

HISTORY.—The almond is one of the most ancient of fruits. Almonds were among the articles which Jacob sent into Egypt to redeem his son.¹ In the Hippocratic writings they are stated to be warming and nutritive, are recommended with squill and honey for internal purulent discharges, in emulsion for pulmonary affections and for leucorrhœa, with honey and wormwood for jaundice, and externally in excoriations about the genitals. Bitter almonds are also directed in hysteria, and for a lotion to remove freckles.² The latter application is mentioned by Dioscorides, who also advises a decoction of the root for the same purpose, a suppository of almonds to bring on the menses, a cataplasm of bruised almonds for pain in the head, &c. Internally, he says, they alleviate pains, open the bowels, promote sleep, excite the urinary secretion, and are useful in hæmoptysis. Five or six bitter almonds taken before supper prevent intoxication. The bitter, he adds, are more useful in medicine than the sweet variety.³ Pliny describes different varieties of the almond tree which, he states, came originally from Pontus, whence the fruit had the name of Pontic nuts.⁴ He attributes to bitter almonds the more active properties enumerated above, and says of sweet almonds that they are less active as medicines, but are laxative and diuretic.⁵ Galen included bitter

¹ Genesis xliv. 11.

² DIERBACH, Arzneimittel des Hippokrates, p. 48.

³ Lib. i. cap. cxxxix.

⁴ Hist. Nat., xv. xxiv.

⁵ Ibid., xxiii. lxxv.

almonds among the attenuant medicines; according to him, they cleanse the liver of inspissated humors, remove spots from the skin, promote the expectoration of mucus, and are useful for pains in the spleen, kidneys, and bowels. By the Arabian authors they are described in nearly the same terms; one, however, prescribes an emulsion of almonds for dysuria, and states that they increase the secretion of semen, another recommends their emulsion for a dry cough, and, according to Rhazes, when eaten with sugar they are fattening in a high degree.¹

1. SWEET ALMONDS.—When deprived, by soaking in hot water, of their epidermis, which is bitter, they have a bland, mucilaginous, and sweetish taste. On being triturated with water they form a white emulsion known as milk of almonds. This peculiarity is due to their containing, besides fixed oil, sugar, and gum, an albuminous substance called *emulsin*, which coagulates at the boiling heat of water, and is precipitated from its solution by alcohol.

Action and Uses.—Emulsion of sweet almonds (MISTURA AMYGDALÆ), which is the form in which they are generally employed in medicine, is demulcent, nutritious, sedative, and slightly diuretic and laxative. It is made by triturating in a mortar half an ounce of freshly-blached almonds with half an ounce of gum Arabic and two drachms of sugar, and then adding gradually half a pint of distilled water, and straining the mixture. It may be used *ad libitum*. It is much used in Europe, and deserves to be in this country, in all internal inflammations, as a demulcent and soothing drink. It is especially useful in acute affections of the air-passages and of the primæ viæ, and in all irritations of the urinary passages. It may also be employed as a vehicle for medicines which tend to nauseate or to irritate the stomach or bowels, but in this respect it is generally inferior to solution of gum Arabic. Externally, it may be applied as a sedative and emollient lotion in all cases of cutaneous irritation.

The *fixed oil of almonds* is a singularly bland and agreeable oil, and very useful as a demulcent. It was particularly recommended by Sydenham in the cough of phthisis, and may be used in all irritations of the respiratory passages. It is prescribed in emulsion.

2. BITTER ALMONDS.—These almonds, which are somewhat bitter to the taste, owe their peculiarities to a proximate principle called *amygdalin*. When the emulsin, which they also contain, is mixed with water, it acts as a ferment upon the amygdalin, converting it into hydrocyanic acid and volatile oil of bitter almonds. The presence of water is essential to these changes, for without it a perfectly bland oil,

¹ EBN BAITHAR, ed. cit., ii. 442.

like that from sweet almonds, can be obtained from the bitter variety by pressure or by heat.

The *oil of bitter almonds* (OLEUM AMYGDALÆ AMARÆ) is obtained by distilling with water almonds from which the fixed oil has been removed by expression. Its active properties depend mainly upon the hydrocyanic acid which it contains, and it forms a convenient mode of administering that agent. It may be prescribed in the dose of a quarter of a drop and from that to a drop and a half in an emulsion.

Action of Bitter Almonds.—As already stated, bitter almonds become poisonous by reaction with the water of the animal secretions; and many instances are recorded of alarming symptoms, and some of death itself having been produced by them in man. According to the experiments of Wepfer a drachm of the pulp is sufficient to kill a pigeon or a kitten; Hiller gave three ounces of bitter almonds to a cat without destroying it, although the animal had convulsions, foamed at the mouth, &c.; Viborg gave a horse as much as three-quarters of a pound of bitter almonds, the pulse became small, and the animal appeared dull, but was not otherwise affected.¹ According to Orfila twenty almonds, each cut into three pieces, will kill a dog in six hours, if the gullet is tied.²

In man, symptoms of poisoning are also produced by these nuts. Orfila relates such a case concerning two children. Within a quarter of an hour pallor and collapse of the features, dilated pupils, sighing respiration, somnolence and muscular relaxation, indicated the nature of the accident. In larger quantities their poisonous effect may be very sudden. A case is reported by Kennedy of a man who fell down dead after eating a large quantity of bitter almonds; there was frothing at the nose and mouth, and the eyes continued fixed and glistening.³ In many instances the bitter almond gives rise to annoying, but less serious, symptoms, and particularly to a copious eruption upon the skin resembling urticaria; but as the sweet almond sometimes has a similar effect, it must be attributed to personal peculiarities, rather than to the poisonous action of the nut.

The *volatile oil of bitter almonds* is one of the most powerful of poisons. According to Mr. Taylor, one hundred parts of the oil contain nearly thirteen parts of anhydrous prussic acid.⁴ One drop of it is sufficient to kill a cat. This was shown by the experiments of Sir B. Brodie, who also illustrated in his own person its subtle power.

¹ WIBMER, *Wirkung*, &c., i. 155.

² *Toxicologie*, 5ème ed., ii. 423.

³ WIBMER, from *Lond. Med. and Phys. Journ.*, Feb. 1827.

⁴ From some experiments by Mr. W. Price Jones, it appears that the purified oil of bitter almonds, *i. e.*, deprived as far as possible of its hydrocyanic acid, is not in a high degree poisonous. (*Lancet*, Jan. 10, 1857, p. 45.)

Dipping the blunt end of a probe into the essential oil, he applied it to his tongue, meaning to taste the oil, for he had no suspicion that so small a quantity of it could produce any of its specific effects on the nervous system; but scarcely had the instrument touched his tongue when he experienced a very remarkable and unpleasant sensation, which he referred chiefly to the epigastric region. At the same time there was a sense of weakness in the limbs, as if he had not command of his muscles, and he thought that he was about to fall. The sensations were, however, momentary.¹ In a case reported by Mertzdorf, the patient, a hypochondriac, forty-eight years of age, swallowed two drachms of the essential oil of bitter almonds. His features became spasmodically contracted, his eyes fixed, upturned, and starting from his head, and the breathing jerking and hurried. Death took place in half an hour.² Several cases of the same sort are reported by Orfila and Taylor. On the other hand, instances are cited by these and other toxicologists to show that large doses of the substance in question may be taken without fatal consequences. Thus, while seventeen drops have been known to cause death, recovery has taken place after a dose of thirty drops, but vomiting occurred in a few minutes after the poison was swallowed.³ A like result ensued in the case of a boy twelve years of age, after taking nearly a tablespoonful of the oil. In this instance remedial measures were at once adopted.⁴ In another case, a boy four years of age swallowed four or five drachms of the oil, and, as in the other examples quoted, violent symptoms were instantly manifested; but assistance was at hand, and in half an hour the patient was out of danger.⁵ From these cases it must be apparent that too much caution cannot be exercised in dispensing this powerful medicine.

USES.—The preceding account shows that the cases to which bitter almonds are applicable, in virtue of their sedative properties, are the same as those in which hydrocyanic acid is administered. In such cases the essential oil may be prescribed, in doses of one-quarter of a drop to a drop, in emulsion. But when a demulcent as well as a sedative operation is required, the emulsion of bitter almonds is to be preferred. It is made in the same manner as the emulsion of sweet almonds (*vid. supra*). It is very palatable, and is an eligible preparation in catarrhal affections of all the mucous membranes. The *syrup of orgeat* (SYRUPUS AMYGDALÆ), which is prepared with both sweet and bitter almonds, is useful under the same circumstances, largely diluted with water. It is commonly prescribed in cases of gonorrhœa to diminish

¹ Physiological Researches, p. 45.

² Journ. Complémentaire, xvii. 366.

³ CHAVASSE, Lancet, 1839, p. 930.

⁴ TAYLOR, On Poisons, Am. ed., p. 572.

⁵ Lancet, Jan. 1855, p. 34.

the acrimony of the urine. The simple almond emulsion forms a soothing lotion for parts irritated by chafing, by exposure to heat, or by slight cutaneous eruptions. As before stated, it has long been employed to remove sunburn and freckles.

CETACEUM.—SPERMACETI.

DESCRIPTION.—“A peculiar concrete substance obtained from *Physeter macrocephalus*.” This cetacean, commonly called the great-headed cachalot, and vulgarly confounded with the whale (*balæna*), inhabits gregariously the Atlantic and Pacific oceans, and formerly was found in every latitude, but it is now chiefly met with in the Southern Ocean. It is from forty to seventy feet in length, and twenty feet in thickness, its upper part is grayish and its belly white; it has a disproportionately large head, two small pectoral and a very large caudal fin, remarkably small eyes, and a single spout hole. Its lower jaw is furnished with large conical teeth, which are received into corresponding depressions in the upper jaw. The spermaceti is a peculiar fluid contained in an immense cavity above and outside of the cranium, and covered with a tendinous and cartilaginous integument. This cavity is subdivided internally into numerous cells communicating with one another, and with canals and dilated portions, all of which are filled with the substance in question. In its recent state it is liquid, but on the death of the cachalot it congeals. Before entering into commerce, it is freed from oil and cellular substance by repeated compression, melting in water, skimming, and washing with a weak alkaline solution.

Pure spermaceti is a white solid, of a foliaceous crystalline structure, and pearly lustre, inodorous and almost tasteless, and of a somewhat unctuous feel. It is insoluble in water, and but slightly soluble in cold alcohol, but is more so in boiling alcohol, ether, and the volatile and fixed oils. It may be pulverized with the addition of a small quantity of alcohol or almond oil. Spermaceti contains neither oleic nor margaric acids, but a peculiar acid, the *ethalic* or *cetylic* (which, however, is stated to be a compound of several other acids), in combination with a base called *ethal*. Accordingly pure spermaceti is an ethalate or cetylate of ethal or the hydrated oxide of cetyl.

HISTORY.—This substance, which does not appear to have been known to the ancients, derives its name from a superstition which prevailed during the middle ages, that it constituted the seminal fluid of the animals from which it is procured. Subsequently it was sup-

posed to be the cerebral substance of these animals. Pomet¹ stated a century and a half ago that it was seldom used in medicine, but chiefly as a cosmetic by ladies of quality.*

USES.—Formerly spermaceti was, as we have both poetical and professional authority for stating, regarded as a sovereign remedy “for an inward bruise.” In fact it was considered a demulcent and sedative remedy for all pulmonary and intestinal affections, and even for painful disorders of the urinary organs. We have known it to be administered in powder with white sugar for the relief of bronchial catarrh. But most frequently it was given for the purposes specified, in the form of an emulsion made with the yolk of egg and sugar, or with almond oil.

Externally, spermaceti is frequently employed as an ingredient of ointments, and is often more eligible than lard for this purpose, on account of its blander qualities and its greater tenacity, especially where a simple protective is alone required. Ointment of rose water (*Unguentum Aquæ Rosæ*), or cold cream as it is popularly called, spermaceti ointment (*Unguentum Cetacei*), and spermaceti cerate (*Ceratum Cetacei*), are preparations of this description. They are especially useful in healing chapped lips and hands and all superficial abrasions, excoriations, and burns. The first named of these, with the addition of a little benzoin to preserve it from rancidity, tincture of alkanet to give it an attractive color, and oil of rose or bergamot as a perfume, forms an agreeable and useful lip-salve.

GLYCERINA.—GLYCERIN.

DESCRIPTION.—Glycerin, or oxide of glyceryle, is a substance existing as the organic base of the fatty acids (stearic, margaric, oleic, &c.), and liberated from them when they combine with alkaline bases to form soaps. It was discovered by Scheele in 1789, and more fully investigated by Chevreul in 1811. From its flavor, Scheele denominated it “the sweet principle of fats,” and hence it received the name which it bears, *glycerin* from γλυκος, sweet. It may be prepared by mixing litharge (oxide of lead) with a fixed oil and boiling water, by which the fatty acids unite with the lead and are precipitated, and the glycerin remains in solution. It is then freed from any lead it may retain, by means of a stream of sulphuretted hydrogen gas, and purified from this latter by boiling, and from other impurities by filtration

¹ Histoire des Drogues, Paris, 1706.

through animal charcoal. According to the U. S. Pharmacopœia, lead plaster (litharge and olive oil) recently prepared, and yet fluid, is mixed with boiling water, which dissolves out the glycerin. It is then treated with sulphuretted hydrogen, filtered, and concentrated as before. Glycerin prepared by these methods is said to be very apt to contain lead. In some specimens antimony has been detected. A more direct method, and one by which a purer glycerin is produced, is that originally patented by Mr. Tilghman, of Philadelphia, and improved by Messrs. Price & Co., of London. It consists in blowing steam at a high temperature (550° to 600° F.) through fat, and receiving the fatty acids and the glycerin in a condenser, where their different specific gravities cause a separation between them, the glycerin subsiding, and the fatty acids remaining supernatant.

Glycerin is a colorless or straw-colored liquid, of a syrupy consistence, with a sp. gr. of 1.25; it is somewhat unctuous to the touch, inodorous, and of a very sweet and pleasant taste. It is perfectly soluble in oils, alcohol, and water, but is insoluble in ether. Its general solvent power is almost equal to that of water, and is greater than that of water for iodine, phosphorus, corrosive sublimate, sulphate of quinia, quinia, strychnia, and veratria. It has no tendency to ferment or become rancid, nor does it evaporate on exposure to the air. It has also the power of preserving animal and vegetable substances from decomposition. If pure from rancid oils, it ought to emit no smell when rubbed upon the warm hand.

ACTION AND USES.—Glycerin is said to be perfectly bland and unirritating, but we have found the purest article occasionally the reverse, owing, it may be, to its abstracting moisture from the part to which it was applied. From the tenacity with which it retains and attracts moisture, it remains unaltered by a high temperature. Mr. Startin affirms that a common plate wetted with it may be kept in an oven, side by side with a joint of meat, till the meat is cooked, without any sensible diminution in the quantity of the liquid.¹ These observations show that a perfectly pure (anhydrous) glycerin is not the best adapted to fulfil the objects to which it is applied as a protective agent.

Like all other substances newly applied to medicinal uses, glycerin has had virtues attributed to it which are probably exaggerated if not unreal. As a *nutrient*, it has been compared with cod-liver oil, and, as it is rich in carbon and hydrogen, the view seemed not unfounded. Dr. Gilchrist used it in a case of mania, where it appeared to retard, if

¹ Am. Journ. of Med. Sci., July, 1846, p. 222.

not to neutralize, the exhausting process.¹ Dr. Crawcour, of New Orleans, substituted it for cod-liver oil in the cases for which this medicine is usually given, and found it successful in several cases of *phthisis*, of *scrofulous disease* generally, and in *mesenteric disease* in children. He also used it as a very convenient vehicle for iron, quinia, and iodine, in the same cases.² Cases illustrative of its use have been furnished by several Scottish physicians.³ Dr. Cotton, Physician to the Brompton Hospital for Consumption, has, however, shown conclusively that glycerin has generally but little influence upon phthysical cases, and that as a remedial agent in consumption, it will bear no comparison with cod-liver oil.⁴

As a *topical* application, the usefulness of this preparation is much more evident. In *dysentery*, an enema containing one part of glycerin to five of flaxseed tea, has been found one of the best means of soothing the irritated rectum, and suspending the tenesmus.⁵ Dr. S. Scott Alison has applied it to the *larynx* and trachea in cases of pulmonary disease attended with dryness or irritation of these parts.⁶ Dr. E. R. Mayer, of Wilkesbarre, Pa., has used glycerin with advantage to soften the plugs of hardened mucus which obstruct the nasal passages in some forms of chronic coryza, and also as a local application to the interior of the larynx in membranous croup. In the latter case he found that when the liquid was applied to the orifice of the larynx, by means of a large camel-hair pencil, there was a manifest softening of the tone of breathing and cough, and considerable reduction of the dyspnoea and general distress.⁷

One of the earliest uses of glycerin was that proposed by Dr. Turnbull. Mr. Yearsley had called attention to the improvement in hearing of persons in whom the tympanum was partially destroyed, when a pellet of moistened cotton wool was introduced into the meatus, but Dr. Turnbull, finding that the necessity of constantly renewing the moisture of the pellet was a great inconvenience, conceived the idea of moistening it with glycerin instead of water, and found this a much more permanent expedient. In other cases of perforated tympanum causing deafness, he filled the auditory canal with a solution of equal parts of glycerin and water, and causing the patient to inspire, in this manner cleansed and lubricated the Eustachian tube.⁸ Mr. Wakley,

¹ Edinb. Journ., ii. 920.

² N. Y. Journ. of Med., March, 1855, p. 309.

³ LINDSAY, Edinb. Journ., ii. 915.

⁴ Med. Times and Gaz., June, 1857, p. 641.

⁵ Bull. de Thér., lviii. 521.

⁶ The Medication of the Larynx and Trachea, p. 20.

⁷ Am. Journ. of Med. Sci., April, 1858, p. 338.

⁸ Lond. Med. Gaz., June, 1849, p. 962.

jr., found this liquid peculiarly serviceable in cuticular or epithelial *thickening of the meatus*, and of the tympanum, producing more or less tinnitus and hardness of hearing. By filling the auditory canal with glycerin, and retaining it in the passage by means of a plug of gutta pereha, the epithelial secretion gradually softens and breaks into pieces which can be removed by means of a syringe or with the forceps.¹

Besides the softening influence exerted by glycerin under the circumstances above stated, it is eminently useful in protecting inflamed parts from the air and external irritants. This is shown by its favorable action upon *wounds* and *ulcerated surfaces*. According to Démarquay, its advantages over ointments as a dressing for wounds consist in its superior cleanliness and facility of application, its un-irritating qualities, and its limiting the secretion of pus.² M. Lutton, who witnessed the results of the treatment used by M. Démarquay, fully confirms these statements, adding that glycerin, by its hygrometric qualities, prevents the hardening of pus upon wounds, and by its miscibility with this secretion comes more perfectly in contact with the affected part than any ointment can do. He assures us that it is preferable to all other dressings for burns, hospital gangrene, and suppurating surfaces generally.³ M. Démarquay has also treated vaginal *leucorrhœa*, after the acute stage, by means of tampons saturated with a solution of one part of tannin in four of glycerin. He reports four cases of rapid and complete cure.⁴

Dr. Brinton made use successfully of a lotion consisting of two scruples of borax, one ounce of glycerin, and four ounces of water, in a case of *fissured tongue* which had baffled all attempts at alleviation for many years.⁵ Van Holsbeck found a tent saturated with a solution of glycerin and tannin (1 part to 16), and introduced carefully into the rectum night and morning, an excellent remedy for *fissures of the anus*.⁶ A similar solution is not less efficacious in the treatment of *fissure of the nipple*; but for this affection, and for *chapped hands*, we prefer a liniment made by adding one part of tincture of benzoin to six or eight of glycerin, and filtering the mixture. A benzoated glycerin ointment is also prepared, and answers a similar purpose.

Glycerin as a remedy for *diseases of the skin* was first used by Mr. Startin in the treatment of *pityriasis* and other squamous disorders,⁷ in 1845, since which time it has been employed by many physicians for

¹ Lond. Lancet (Am. ed.), July, 1852, p. 39.

² Bull. de Thérap., xlix. 422.

³ Abeille Méd., xiii. 31.

⁴ Bull. de Thérap., l. 540.

⁵ RANKING'S Abs. (Am. ed.), xxv. 89.

⁶ Bull. de Thérap., li. 475.

⁷ BRAITHWAITE'S Retros. (Am. ed.), xiii. 307.

similar purposes. Among them Mr. Shaw made use of it in pityriasis,¹ Trousscau and Bazin in *prurigo*,² Sère de Muret in the same affection,³ Bourguignon in *scabies*,⁴ Stirling in *psoriasis*,⁵ and Bougard in *eczema*.⁶ It has, indeed, been used in almost every description of cutaneous eruption, and for the relief of the *stings of insects*. In many cases of the former it evidently aggravated the disease by the irritant qualities of the glycerin employed, and in few or none did it evince any superiority to the fatty substances usually employed. Dévergie, who made extensive trials of it, arrived at such a conclusion as this, and observed further that when a large portion of the body was covered by the preparation its affinity for moisture kept the clothing of the patients constantly wet, and in cold weather rendered them very uncomfortable.⁷ On the whole, it appears, in this class of disorders at least, to act a purely mechanical part, and protect the affected surfaces from the contact of the atmosphere, without materially modifying their condition. In recent or other local affections which tend to a spontaneous cure, glycerin may hasten that issue, but beyond this it displays no curative virtues.

As a vehicle, solvent, or excipient, for pharmaceutical preparations. The remarkable solvent powers of glycerin, together with its bland taste, its unchangeableness, and its neutral relations to the animal tissues, render it, when unadulterated, one of the most valuable excipients that can be used, especially for those medicines which, as above stated, it dissolves more perfectly than water. Mr. Wilson has found that its solutions of the sulphate and the iodide of quinia, of the citrate, iodide, proto-carbonate, and perphosphate of iron, of tannin, of iodine, &c., form very elegant and permanent preparations.⁸ A solution of iodide of potassium in two parts of glycerin with the addition of one part of iodine, makes an almost caustic preparation of the greatest value in the treatment of lupus, &c. But a solution of one part of iodine in five of glycerin is sufficiently strong for obtaining the resolvent action of iodine upon enlarged glands, or its revulsive operation in cases of deep-seated disease of the joints, &c. It is recommended to paint the part with the iodized solution once in two or three days, and to cover it with a piece of gutta percha cloth. Prof. Simpson, of Edinburgh, has used a paste made with one part of glycerin and eight parts of powdered sulphate of zinc as a *caustic*. Dr. Andrews, of Chicago, states that a solution of the vaccine scab in glycerin keeps for months, even in warm weather, without spoiling, and answers perfectly for vaccination.⁹

¹ Times and Gaz., April, 1854, p. 347.

² Annuaire de Thérap., xvii. 245.

³ Ibid.

⁴ Bull. de Thérap., l. 241.

⁵ Am. Journ. of Med. Sci., Oct. 1857, p. 561.

⁶ Arch. Gén., 5ème sér., iii. 244.

⁷ Edinb. Med. Journ., ii. 921.

⁸ Bull. de Thérap., li. 323.

⁹ Edinb. Med. Journ., ii. 924.

OLEA FIXA.—FIXED OILS.

OLEUM OLIVÆ.—*Olive Oil.* See *Cathartics*.

OLEUM AMYGDALÆ.—*Almond Oil.* See *Amygdalæ, supra*.

OLEUM seu BUTYRUM CACAO.—*Cocoa oil or butter.*

DESCRIPTION.—This substance is the oil obtained by expression from the seeds of *Theobroma cacao*, a native tree of tropical America. Chocolate consists of these seeds roasted, ground, and mixed with various nutritious or spicy substances.

Cocoa oil or butter is a soft solid of a yellowish-white color, and an agreeable odor and taste; it melts at 95° F., consists of peculiar acids and oils (coccinic, caproic, &c.), and may be kept, it is said, for twenty years without growing rancid. It is but slightly soluble even in warm alcohol, but dissolves readily in ether.

USES.—It has been used internally as a nutrient and emollient remedy, in cases of chronic affections of the lungs and alimentary canal. It is, however, more frequently employed as a dressing for excoriated surfaces, &c. Its mildness renders it superior to lard for this purpose, and it is more emollient than spermaceti.

On account of its slight liability to undergo change, this substance forms an excellent covering for surgical and other steel instruments which are exposed to a damp or salt atmosphere.

SEVUM.—SUET.

DESCRIPTION.—Suet is the prepared fat of the sheep. It was used by the ancients in medicine. Galen ascribes to it qualities more heating and desiccative than those belonging to lard. It contains stearin, olein, and a peculiar liquid principle called hircin.

USES.—When perfectly fresh, suet forms a suitable dressing for blistered and other excoriated surfaces; but it is very apt to grow rancid, and is then decidedly irritant. It is used as an ingredient of various ointments, cerates, and plasters in order to give them a firmer consistence than they would derive from lard.

GELATINOUS LENITIVES.

GELATINA.—GELATIN.

DESCRIPTION.—Gelatin is a solid, transparent, corneous substance, which forms the greater part of the bones, tendons, skin, cellular tissue, and serous membranes of animals. In flesh it is associated with osmazome. It is soluble in boiling water, and forms, on cooling, a transparent jelly. When dried, it becomes whitish or yellowish, semi-transparent, hard and tough, has no taste or smell, and is unchanged by exposure to dry air.

ACTION AND USES.—The experiments of Tiedemann and Gmelin, Edwards, Magendie, and others show that pure gelatin is incapable of supporting animal life, but that this substance may become nutritive when it is combined with other principles, as it is in soup prepared from meat.¹ Pure gelatin is sometimes used for the preparation of soups and jellies for the sick, but they are apt to produce laborious digestion and its consequences. It may, however, be sometimes used in solution as an enema in cases of dysentery with severe tenesmus, hæmorrhoids, &c. It has likewise been applied to cutaneous eruptions in order to protect them from the air, and in general baths to soften the skin.

A very important application of gelatin is to the formation of capsules for the administration of offensive liquid medicines, such as opoiba. Of the same material small cylinders are made, and closed at one end, so that when two of them are fitted into each other by their open extremities, a pill or other small body inclosed within them may be swallowed without offending the palate. Gelatin is also used as a coating for pills, which are dipped into the substance while it is in a liquid state, and are then allowed to dry.

ICHTHYOCOLLA.—ISINGLASS.

DESCRIPTION.—Isinglass is a gelatinous substance prepared chiefly from the swimming bladder of *Acipenser huso* (sturgeon) and other

¹ On this subject, see an interesting report by M. Bérard; Bull. de l'Acad. de Méd., xv. 367.

species of *Acipenser*. Geoffroy states that isinglass is prepared from the skin, entrails, fins, and tail, as well as the swimming bladder of the fish;¹ but the Russian, which is the best variety, is composed entirely of the last-named organ opened, stretched, and dried.

Isinglass comes in rolls or folded sheets, which are semi-transparent, smooth and shining, tough and not easily torn except in the direction of the fibres, and without smell or taste. Inferior sorts are more opaque, of a duller aspect, and sometimes of a fishy taste and smell. Cold water softens it, but boiling water dissolves it perfectly, and on cooling, forms with it a jelly. It contains seventy per cent. of gelatin, and is consequently richer in this constituent than any other natural product.

HISTORY.—Celsus mentions isinglass among agglutinant remedies.² Pliny describes it as the skin of a fish, says that it is soluble in water and vinegar, and is used for pain in the head, and to hide wrinkles and cure eruptions of the skin.³ Dioscorides and Paulus Ægineta give the same particulars.

ACTION AND USES.—Isinglass is emollient and nutritious. It is used occasionally in affections of the lungs and bowels, and is peculiarly adapted to cases of chronic diarrhoea and dysentery in children. Dr. John F. Meigs speaks in high praise of the following preparation of isinglass in the cases referred to, and also as a substitute for breast-milk when this cannot be procured of the proper quality. Take a scruple of isinglass, soak it for a short time in cold water, and then boil it in half a pint of water until it dissolves. To this, for a child of a year old, add with constant stirring, and at the termination of the boiling, four ounces of milk well mixed with a teaspoonful of arrowroot, and just before removing from the fire, one or two ounces of cream. Loaf sugar may then be added.

Court-plaster is made by covering strong silk stuff with a solution of isinglass and tincture of benzoin, or coating oiled silk with a solution of isinglass.

Although not belonging to gelatinous substances, the physical properties and the uses of collodion appear to render this an appropriate place for its description.

¹ Suite de la Mat. Méd., ii. 27.

² GRIEVE'S CELSUS, p. 208.

³ Hist. Nat., lib. xxxii. cap. xxiv.

COLLODIUM.—COLLODION.

DESCRIPTION.—Collodion is a solution of gun-cotton in ether and alcohol. It is a colorless and perfectly transparent liquid, of the consistence of a thin syrup, and smelling strongly of ether. By exposure to the air the solvent evaporates, and the solution grows thick, depositing acicular crystals of gun-cotton.

The introduction of collodion into practice is usually ascribed to Dr. J. P. Maynard, when he was a student of medicine in Boston, in the early part of 1848. It was employed by his preceptor, Dr. Whitney, in more than one hundred cases of surgery, some of which were serious, and in all successfully.¹ Dr. H. J. Bigelow, however, claims to have first discovered its qualities and applied them in practice.² In the year above mentioned extensive trials of it were made in England, and especially by Mr. Erasmus Wilson, in diseases of the skin.

ACTION.—The peculiar properties of this substance depend upon the evaporation of its ethereal portion, in consequence of which it solidifies, and in doing so contracts and becomes strongly adhesive. When, therefore, a portion of the skin is covered with a layer of collodion, a sensation of coldness is experienced, which lasts until the evaporation is completed, and is followed by a sense of constriction, which, if the preparation is applied over a large, or at all sensitive surface, becomes unpleasant, or may even be decidedly painful. Both of these operations, it is evident, tend to drive the blood away from the part and to hinder its complete return so long as the coating is unimpaired, and in this manner to moderate vascular action in inflammation, preventing, also, or limiting effusion, promoting the absorption of that which is already formed, and, in a word, favoring the occurrence of resolution, the most desirable end of inflammation. But collodion does more than this; it is eminently protective in its operation. Better than the mucilaginous, oily, and other applications of the class, it entirely excludes the part which it covers from the air, by means of an artificial cuticle which is but little affected by moisture, and which is so transparent that the condition of the tissues beneath it can at any time be seen. Its adhesiveness renders the other qualities with which it is associated more permanent, relieving both patient and medical attendant from the necessity of a frequent change of dressing, and enabling the latter to employ mechanical arrangements in

¹ Am. Journ. of Med. Sci., April, 1848, p. 578.

² RANKING'S Abstract (Am. ed.), viii. 217.

the treatment of wounds and other injuries, which would be very difficult, if not impossible, without it.

USES.—Collodion was at first, and is still, employed as a substitute for adhesive plaster in the treatment of *wounds*. The edges of a wound being accurately adjusted, the skin is thoroughly dried, and covered with collodion by means of a brush, each layer being allowed to harden before another one is applied. Among the early achievements with this agent was the successful treatment of a lacerated wound of the perineum in a female. For deep wounds, it was employed in conjunction with strips of cotton cloth, and sheep-skin, together with raw cotton, forming strong, unyielding, adhesive straps, bandages, and enemas. In a case of lacerated wound of the scalp, Dr. Whitney, fearing that sutures might excite erysipelatous inflammation, shaved the hair from the raised scalp, and, by means of collodion, fastened some short and narrow strips of sheep-skin on each flap, a short distance from their edge. These strips were then drawn towards each other until the edges of the wound were brought into close and exact union, and the free ends of the strips were secured together by sutures.¹ After a lapse of eleven years M. Goyrand, of Aix, apparently in ignorance of the ingenious device of Dr. Whitney, published an account of his successful use of the same method in the treatment of deep wounds.² Dr. Goyrand makes use of linen instead of parchment, and of strings to be tied instead of a suture, both of which means are probably inferior to those originally proposed and employed.

In the treatment of *ulcers* collodion has been found very serviceable under two circumstances, when the ulcer is indolent, and when it is in a situation which exposes it constantly to irritation. In the former case the ulcer should be perfectly dried before the application is made, and then the collodion is to be laid on, beginning with the surrounding skin and gradually coating the ulcer itself, leaving, however, a small opening in its centre for the escape of its secretions. In the other case, as when the ulcer is seated on the neck of the uterus, Dr. Mitchell, of Dublin, found that by its protecting and constringing power, collodion effected a cure in half the time which is required when nitrate of silver is used.³ Similar testimony has been furnished by Aran⁴ and by Delpuch.⁵ On the same principle, Yvonneau treated a case of fistula of the cheek, using collodion to keep the edges of the incision together.

¹ Am. Journ. of Med. Sci., April, 1848, p. 578.

³ Dublin Med. Press, Oct. 1848.

⁵ Ibid., li. 176.

² Bull. de Thérap., lvi. 335.

⁴ Bull. de Thérap., xlv. 34.

In other minor cases, the insolubility of this substance in watery liquids has been found of great use, particularly to preserve slight abrasions or wounds from infection in *dissection*, *surgical operations*, the practice of *midwifery*, &c. Mr. Robinson found it useful as a filling for *carious teeth* when the nerve is exposed. After the cavity is cleansed and dried, he recommends that it should be filled with a small tuft of asbestos saturated with collodion in which morphia has been dissolved.¹

In other cases it is useful by its constringing as well as its protective property. It serves to arrest excessive bleeding from *leech-bites*, when applied on a small compress to their orifices, and renewed as often as the hemorrhage reappears,² and also to protect and heal the wounds made by the scarifier in *cupping*.

In *erysipelas* collodion has sometimes been applied with the best effects. The first record of its use in this disease, is that of Dr. Freer, of Illinois, who found, during an epidemic of the disease, that its application gave immediate relief to the local symptoms.³ Piachaud, of Geneva, reports fifteen cases of erysipelas of the face, in which its influence upon the heat, tension, and throbbing of the part was immediate, the redness at once subsided, and the disease was cured in one-half the time usually required.⁴ In order to diminish the constriction of the application, which is sometimes very painful, P. Guer-sant mixes castor oil with the collodion, in the proportion of one part to fifteen. It must be remembered, however, that erysipelas is not always a local disease. Although in many cases, even of the idiopathic form, it exhausts itself in the neighborhood of the parts first attacked, it in many others travels beyond them, whatever may be the local treatment employed. This remedy is, doubtless, most effectual, as Christen has pointed out, in erysipelas depending upon local causes, such as wounds, ulcers, solar heat, burns, &c.;⁵ it is, however, spoken of by Mr. Erasmus Wilson as a valuable topical agent in erysipelas. It also forms an excellent application for superficial *burns*, according to the reports of Drs. Payne and Crawford, in Canada,⁶ and of Lambert, at Lyons.⁷

In *smallpox* it was natural that collodion should be employed as an eectrotic remedy, to prevent the development of pustules upon the face and the unsightly scars which too often follow them. The first trial of this treatment in a case of unmodified smallpox, was made by Aran,

¹ Lancet, Dec. 1848.

² Lancet, Jan. 1849.

³ Am. Journ. of Med. Sci., April, 1850, p. 545.

⁴ Archives Gén., Sept. 1852, p. 5.

⁵ Vierteljahrsschrift f. d. prakt. Heil., xxxvi. 92.

⁶ Brit. Am. Journ., Aug. 1848.

⁷ Dieu, Mat. Med., iv. 489.

in 1850, and appears to have been successful in preventing pitting;¹ but the more numerous trials of Christen, at Prague, led him to conclude that collodion thus applied produces intolerable suffering, does not in any degree retard the development of the pustules, and even seems to be the cause of increased ulceration of the skin.² These effects appear to have depended chiefly on the constrictive action of the coating, which may be diminished, while the pliancy of the pellicle is increased, by the addition of about one-fourth part by weight of castor oil to the collodion. Dr. Elisha Harris, of the Marine Hospital, New York, reports as the result of several years' experience, that although the simple collodion dressing does not, in the majority of cases, insure against suppuration and pitting, yet it seems in a large proportion of cases, to diminish these unpleasant accidents of the malady. He preferred an opaque solution made by the addition of one ounce of tincture of kino, and two drachms of muriated tincture of iron, to three ounces of collodion. With this each vesicle, or patch of vesicles, was pencilled, from its first development, three or four times daily, and until desiccation was about to commence.³

This application has been used with more or less advantage in various diseases of the skin, as *intertrigo*, *herpes labialis*, *h. præputialis*, and *h. zoster*; *lichen*, *lupus*, *acne*, *chronic erythema*, &c. Two cases of shingles are reported to have been greatly relieved, and rapidly cured by this method of treatment.⁴ Fissures and excoriation of the *nipples* are more speedily healed by this than by any other application. It is also useful in fissures of the lips and in cases of chapped hands.

The constrictive action of collodion has been rendered very useful in the following affections. According to Bonnafont, who employed it in fifty-five cases of *swelled testicle*, it manifests great energy, especially when the attack is recent, and before the effusion has become solid or organized. In employing it, M. B. directs that it should first be applied to the scrotum near the root of the penis, and gradually extending downwards and somewhat to the opposite side. The application is said to be painful at first, but the pain is not of more than a few minutes' duration.⁵ It has also been used with advantage in *varicocele*.

A zone of collodion, an inch and a half or two inches wide, applied around the *nipple*, at the distance of half an inch from this latter, is said to have been a very efficient means of causing its projection in

¹ Bull. de Thérap., xxxix. 369.

² Prager Vierteljahrs., loc. sup. cit.

³ New York Journ. of Med., July, 1856, p. 137.

⁴ Lancet, April, 1859, p. 378.

⁵ Bull. de l'Acad., xix. 584.

some cases where it was so much retracted that the infant was unable to nurse.¹

Mahy reports his complete success in treating a case of *umbilical hernia* in an infant, with this application, and Pradier also used it with success.² In a similar case we have used it with decided advantage, without, however, as yet, effecting a perfect cure.

A variety of substances, particularly of a caustic nature, have been associated with collodion and applied by its means. Such are iodine, corrosive sublimate, perchloride of iron, cantharides, sulphates of copper and zinc, iodide of zinc, chromic acid, croton oil, &c. The advantages of such a combination are, that by its means many active medicines can, without difficulty, be kept in contact with parts which are habitually bathed in moisture, or which from their situation render a merely mechanical adjustment of the remedy inconvenient and difficult, if not impossible.

APPLICATION.—In all applications of collodion, the part should be rendered as dry as possible. After the first touch of the camel-hair brush, which ought generally to be used, the collodion should be allowed to dry before a second coating is applied. For protective purposes, a thin layer is sufficient, but to produce constriction, a thicker coating is required. In dressing wounds, a piece of patent lint, or of linen cambric, saturated with the liquid, should be laid upon the part after the edges of the wound are accurately coaptated. If contraction of the collodion is objectionable, this effect may be prevented, and the dressing rendered pliant by the addition to the collodion, of some oleaginous substance, as castor oil, already mentioned, or linseed, cod, or lard oil, in the proportion of half a drachm or a drachm, to an ounce of collodion.

SACCHARINE LENITIVES.

GLYCYRRHIZA.—LIQUORICE ROOT.

DESCRIPTION.—The officinal liquorice root is derived from *Glycyrrhiza glabra*, a native plant of Southern Europe and Syria, but cultivated in France, Germany, and England. The plant has herbaceous stems four or five feet in height, with alternate pinnate leaves, and

¹ Bull. de Thérap., lv. 139.

² Edinb. Med. Journ., Jan. 1859, p. 664.

axillary racemes of blue or white flowers, followed by seed-pods or compressed legumes containing three or four brown kidney-shaped seeds. The root, or rather underground stem, is five or six feet long, and penetrates the soil deeply. When dried and brought into commerce, liquorice root consists of pieces usually about two feet in length, and varying in thickness from a quarter of an inch to an inch or more, wrinkled, and grayish-brown externally, but internally of a yellowish color, rendered brighter by moisture. Its structure is fibrous, and its fracture short and splintery. When chewed it has a sweet but slightly acrid taste; the sweetness of its powder is still more marked. Its virtues are extracted both by alcohol and water. They appear to depend mainly upon a peculiar principle called *glycyrrhizin* by Robiquet. It is not crystallizable, is soluble in boiling water and alcohol, has a very sweet taste, and differs from sugar mainly in not being susceptible of the vinous fermentation. Liquorice root contains, besides gum and starch, an acrid resinous substance, albumen, and saline matters.

A variety of liquorice, known as *Russian*, is the product of *G. echinata*. The root is short, thick, porous, of a light color, and not so sweet as the officinal sort. It usually comes deprived of the outer bark.

EXTRACT OF LIQUORICE (EXTRACTUM GLYCYRRHIZÆ) is prepared from the root of the officinal variety by evaporating a decoction of the root. It is produced on a large scale in Calabria and Spain. It is usually in black sticks about six inches long and one inch in diameter, flattened upon one side, and rounded at the ends. It is brittle when cold and dry, but soft and tough in warm and moist weather. In the former case its fracture is very black and shining, and it has a sweet but somewhat acrid taste. When refined it loses in some degree the last named quality, and with it probably some of its virtues.

HISTORY.—Liquorice root (γλυκύριζα, *sweet root*) was well known to the ancients. Hippocrates alludes to it as an external application with honey or ointment of roses.¹ Theophrastus speaks of its usefulness in oppressed breathing and cough, and of its peculiar power of allaying thirst.² Dioscorides says it abounds in Cappadocia and Pontus, that its juice is preserved by inspissation, that it is useful in hoarseness, sore throat, and internal inflammations, and that it quenches thirst.³ Galen only adds that it has a slight astringency, and the Arabians dwell upon its virtues in affections of the respiratory organs.⁴ To this

¹ DIERBACH, *Arzneim. des Hippoc.*, p. 75.

² *Hist. Plant.*, lib. ix. cap. xiii.

³ *Mat. Med.*, lib. iii. cap. v.

⁴ EBN BAITHAR, *ed. cit.* ii. 67.

day itinerant venders of liquorice water (*marchands de coco*) abound in Paris, where they are greatly in favor with the populace.

ACTION AND USES.—Liquorice has at all times been regarded as an agreeable demulcent, having a peculiar tendency to the bronchial mucous membranc. Hence it is sometimes ranked among expectorant medicines. Its *extract* enters as a corrigent into a great variety of preparations, the confection of senna, for example, the fluid extract and syrup of sarsaparilla, various troches or lozenges, the brown mixture, &c. It is peculiarly adapted to correct the acrid taste of certain medicines, such as senega, mczercon, guaiacum, and sal ammoniac. The infusion is employed for similar purposes, and is also a very useful drink in febrile affections attended with much thirst, in diarrhoea, dysentery, diseases of the urinary passages, bronchial inflammations, &c. In these cases it is usual to employ either the root or extract as an addition to mucilaginous infusions, as of flaxseed, barley, gum, &c. A small piece of the extract held in the mouth tends to allay cough and keep the fauces moist.

MEL.—HONEY.

DESCRIPTION.—Honey is defined “a liquid prepared by *Apis mellifica*,” but other species of bee in different countries produce it. The liquid contained in the nectaries of many plants, and which the bee extracts, is believed to undergo a change in the insect’s stomach, and is then thrown up and deposited in the hive as honey. It always partakes in some degree of the qualities of the flowers from which it is derived, and while in some instances, as those cited below from the ancients, it acquires in this manner a peculiar and delightful flavor, in others it becomes, for a similar reason, absolutely poisonous. The honey which has been much used of late years, and is made by bees fed in part upon sugar and water, is a pure but very feeble and insipid product.

The best honey is that known as *virgin honey*, and is procured by draining the comb of young bees. It is of a light amber color, less fluid than water, and sometimes as viscid as oil. By age it becomes still denser and darker, and contains crystalline masses. It has a peculiar odor which in the most esteemed sorts depends upon the flowers which furnish it; the taste is in like manner various, but is always very sweet, and leaves after it, especially in the fauces, a slightly acrid impression.

Honey contains crystallizable and uncrystallizable sugar, mannite,

coloring matter, gum, and wax, together with a volatile odorous principle, which varies with the flowers from which it is derived.

HISTORY.—In the sacred writings honey is repeatedly mentioned as food and medicine, and as an emblem of a fruitful land. The Grecian poets celebrated the honey of Hymettus, a hill near Athens, whose base and sides are covered with heath and fragrant flowers. The honey gathered there has even now lost nothing of its ancient reputation. In the Hippocratic writings honey is described as drying and heating unless largely diluted, in which case it was said to purge off bile, but to allay mucous diarrhoea. It was also reported to be diuretic, was recommended with butter in chronic coughs with wasting flesh; with water it was reputed to appease coughing and promote expectoration. Externally it was employed as an emollient, and as adapted to cleanse foul ulcers.¹ Besides Hymettus, Dioscorides mentions Hybla as scarcely less celebrated for the quality of its honey. Hybla was situated near the south side of Mount Ætna, in Sicily. Like his predecessors, Dioscorides speaks of honey as being detergent, aperient, &c., and adapted to the treatment of foul and fistulous ulcers, and to curing wounds slow to heal. With alum it is stated to be a good application in inflammations of the skin; and with rock salt, and dropped into the ear, a remedy for tinnitus and pain in this organ. It is also stated to be destructive of lice when applied to the head, and to soften and permit the elongation of the prepuce. Particularly it is recommended as a mouth-wash and gargle in inflammation of the tonsils, uvula, and throat. Amongst other things, this author mentions that honey made in the spring is superior to that gathered in the summer or autumn, and that some varieties of it are poisonous in consequence of the bees living upon certain flowers.² Pliny furnishes a full and very interesting account of the natural history of the bee, and the production of honey.³ He also describes the medical uses of the latter, and of its various compounds, particularly hydromel, mead, and honeyed wine.⁴ The Arabian writers state that honey is apt to disagree with persons of an ardent or bilious temperament; and that when gathered from wormwood blossoms it is stomachic and useful to the liver. They dwell particularly on its advantages in affections of the mouth and fauces, and especially of the gums, and recommend that for curing these disorders it should be mixed with vinegar. They also speak of its singular maturative virtues when mixed with flour and used as a poultice.⁵

¹ DIERBACH, *Arzneim. des Hipp.*, p. 75.

³ *Hist. Nat.*, lib. xxi. cap. xli.

⁵ EBN BAITHAR, ed. Sontheimer, ii. 191.

² *Mat. Med.*, lib. ii. cap. lxxv.

⁴ *Ibid.*, lib. xxii. cap. l.

ACTION AND USES.—Honey may be used with other food without any unpleasant effects, in most instances; but there are persons who cannot take even a small quantity of it without feeling the head confused or heavy, while in other cases it generates gas in the stomach and bowels, or occasions diarrhœa. Authors who have treated of the subject also agree that the honey of particular localities is poisonous in consequence of its being derived from certain noxious plants. Mr. Taylor mentions the oleander (*Nerum oleander*) as one of these plants. *Azalea pontica*, *Daphne mezereum*, *Aconitum*, *Kalmia latifolia*, and others, have also been found to be sources of poisonous honey. Of the poisonous influence of the last mentioned plant, commonly known as *mountain laurel*, a well known instance is related by Dr. B. S. Barton. The honey of bees fed from it prove highly intoxicating. The usual symptoms are dimness of sight, or vertigo, succeeded by delirium, which is sometimes mild and pleasant, and sometimes ferocious, ebriety, pain in the stomach and intestines, convulsions, profuse perspiration, foaming at the mouth, vomiting and purging, and in a few instances, death. Such were the symptoms recorded by Xenophon as produced by honey during the retreat of the Ten Thousand. At the present day the *internal* use of honey is very limited, sugar having taken its place in many of the formulæ employed by the ancients. It still enters into some expectorant mixtures, as *Mel Rosæ*, and *Oxymel Scillæ* (*U.S.*), and *Oxymel* (*Lond.*), besides several confections, to which, however, it communicates no peculiar virtues. Yet it may perhaps be doubted whether the substitution of sugar for honey in pectoral medicines, is, on the whole, a profitable change. Geoffroy says it is very appropriate in affections of the lungs with copious and tough expectoration. Honey is sometimes used as a component of laxative enemata, but it has no advantages over molasses.

As a *local* application, honey is employed in all cases in which a mild stimulant is required, and chiefly to change the character of ulcerated or secreting surfaces, when their condition indicates a slow or imperfect movement towards cure. Hence it has in all ages been applied to the gums and buccal mucous membrane to cure aphthæ and slight pseudo-membranous deposits, but it is now usual to associate with it borate of soda, which materially increases its efficacy. For these purposes also *honey of roses* and *oxymel* are superior to honey alone. It is sometimes used as a cataplasm to promote the suppuration of boils, and to heal fissures of the nipple. For these and similar purposes honey is extensively used as a domestic remedy in Russia.¹

¹ KREBEL, Volksmedizin und Volksmittel Russlands, 1858.

SACCHARUM.—SUGAR.

DESCRIPTION.—Sugar is a sweet principle contained in the juice of many plants, in milk, and in the urine of diabetic persons. It is of two kinds, the crystallizable and the uncrystallizable. The former, which is also called *cane sugar*, is derived chiefly from the sugar cane, the sugar maple, and the beet-root; but it also exists in the palm, in many vegetables, as the pumpkin and turnip, and in unripe Indian corn. The latter, called *grape sugar*, and also *glucose*, exists naturally in the juice of grapes and of many ripe acidulous fruits, and in diabetic urine. It is also formed from cane sugar when the latter is passing into alcohol by fermentation, and it exists in molasses.

Officinal sugar is derived from *Saccharum officinarum*, or sugar cane, an herbaceous plant which is a native of, and is chiefly cultivated in tropical countries. It has a general resemblance to the Indian corn, and is composed of a solid many jointed stem, measuring from six to twelve feet in height, and about two inches in diameter at its thickest part, which also is richest in sugar. The leaves are long, narrow, and sharp, and the flowers, which form a panicle at the summit of the plant, are of a pinkish color.

When the cane is ripe, the tops are cut off to serve for replanting, and the stalks having been removed close to the ground are crushed in a mill, and their juice is received into large caldrons. It is then gently heated and mixed with a small proportion of milk of lime in order to facilitate the removal of the impurities which rise to the surface. After this operation, the saccharine liquor is rapidly boiled until it reaches a degree of concentration at which it will crystallize upon cooling. It is then drawn off into a large and shallow reservoir where it cools and undergoes partial crystallization, after which it is transferred either to hogsheads in which the crystallization is completed, and by means of holes in their bottom the molasses is drained off, or it is placed in inverted conical earthen pots open at the apex, so as to allow the liquid portions of the contents to escape. In this condition the product is known as brown sugar. It may, however, undergo a further purification, which consists in placing upon the base of the cones of sugar, prepared in the manner just described, a mass of moistened clay, from which the water percolates through the loaf and carries the impurities with it. It is now more usual to employ refined syrup for this purpose. When prepared for the table and for the use of the pharmacien, confectioner, &c., sugar is still further purified by boiling it with lime-water, or with bullock's blood and ivory

black. In order to prevent the decomposition which sugar undergoes at a high temperature, the process is conducted in partially exhausted receivers by means of steam. The resulting solution is transferred to moulds, where it gradually hardens, and is then cleansed by percolation in the manner above described. After this process it is dried, and is known as loaf sugar.

As thus prepared, sugar is of a snow white color, hard, brittle, porous, and composed of crystalline grains. By friction it becomes phosphorescent in the dark. It is soluble in hot water in all proportions, and in about half its weight of cold water. When its concentrated aqueous solution is allowed to cool slowly, large prismatic transparent crystals are formed, which are known as rock candy. Barley sugar is a transparent amorphous mass made by rapidly cooling sugar melted at a temperature of 356° F. Sugar is soluble in hot, but not in cold alcohol.

HISTORY.—Rumphius says¹ that the word sugar is derived from an ancient Indian word, *saccar*, and Ainslie states that this term (or *sakkara*), is used to designate manufactured sugar. According to Royle, a similar name, which he writes *jaggary*, is given only to palm sugar in India. Sugar from the cane has been manufactured in Hindostan, Siam, China, and Japan, from the most remote antiquity, and at this day its consumption in those countries is enormous, in the form either of raw sugar or of *sugar candy*. The latter is chiefly used in China, where it is said to have been originally made. The etymology of this term has somewhat perplexed historians. Rumphius derives the word candy from *κάυθος*, a cake, from the shape of the masses in which it was prepared. So the French use the word *pain*, and the English the word *loaf*, both of which imply the same idea. Salmasius derives candy from *καυτός*, angular, on account of its splintery fracture. Moseley asks if it does not come from the Indian word *khand*, which, as well as *shukkur*, is a common appellation of sugar in Hindostan?

The first historical allusion to sugar in the writings of Western nations, is furnished by Theophrastus, who lived B. C. 321. He speaks of a sort of honey procured from canes or reeds. Varro, B. C. 68, mentions the exceeding sweetness of the Indian reed (*Indica arundo*), but says that the juice is derived from the root of the plant. Lucan, in an often quoted line, says of the Indians near the Ganges, "They drink the sweet juices of the tender reed." Dioscorides, in his chapter on Honey, remarks, "There is a sort of concreted honey which is called

¹ Herb. Amboinense (1747), v. 189.

sugar. It is found upon canes in India and Arabia Felix. It is as hard as salt, and, like this substance, is brittle under the teeth."¹ To this description Pliny adds, "It comes in fragments as large as a filbert, and is only used in medicine."² Paulus Ægineta quotes Archigenes as saying: "The Indian salt is like common salt in color and consistence, but resembles honey in taste."³

Before the discovery of America or the passage of the Cape of Good Hope, sugar was made in Sicily and in the islands of the Levant. The cane is supposed to have been originally brought thither from India by the Saracens, and thence transplanted to Spain by the Moors. From these countries it was carried, in the 15th century, to Madeira and the Canary Islands, and thence its culture extended to the island of St. Thomas, in the Gulf of Guinea, where, for a long time, the Portuguese carried it on with great success. Piso says that brown sugar only was produced at this place. It is generally stated that on the discovery of the Western Hemisphere, sugar cane was found growing on the continent, and also on some of the Atlantic islands; but that the art of making sugar was introduced by Europeans.⁴ According to Piso, the sugar cane in the province of Rio de la Plata grows spontaneously, and, under the influence of the sun's heat, its juice exudes and crystallizes.⁵ This account corresponds with that of Dioscorides, which has been called in question, because, under the ordinary circumstances of its culture, when the cane is annually cut down, it does not exude its juice. It may be mentioned, without, however, attributing too much importance to the opinion, that Guibourt denies that the sugar cane is indigenous to any part of America.⁶

In regard to the early notions respecting the action and uses of sugar, the following statements may suffice. Dioscorides says: "Sugared water loosens the bowels, and is salutary to the stomach and bladder, and to ulcers of the kidneys. It is also used as a resolvent application to the eyes." Galen compares it with honey, and describes it as cleansing and laxative, and as useful to the stomach, unless the habit is bilious. The Arabians add to these particulars but little of their own, but one among them mentions the still popular remedy, butter and sugar in hot water for hoarseness, and asserts that the fumes of burning sugar cure erysipelatous eruptions. Rhazes says that its excessive use irritates the bowels and debilitates the whole system. According to

¹ Mat. Med., lib. ii. cap. lxxv.

² Hist. Nat., xii. xvii.

³ Syd. Soc. ed., i. 318.

⁴ MOSELEY, A Treatise on Sugar, p. 14.

⁵ De Indiæ utriusque re nat. et med., p. 108.

⁶ Hist. des Drogues, 4ème éd., ii. 117.

Avicenna, sugar is less apt than honey to excite thirst, and is also less detergent. The former of these statements is remarkable, for we find at the present day all the southern nations of Europe employing sugared water as peculiarly adapted to quench thirst.

More modern writers are divided in opinion concerning the usefulness of sugar. The first writer who ascribed to it injurious qualities, was Angelus Sala (*Saccharologia*, 1637), but he speaks only of its excessive use as tending to impair the appetite and digestion, to cause caries and loosening of the teeth, and foul breath, colic, and diarrhoea, besides bilious, scorbutic, and hysterical complaints. Subsequent writers attributed to its ordinary use greater evils still. Garancières accused it of aggravating and even of causing consumption of the lungs, and maintained that since bitter substances preserve from putrefaction, sweet ones must favor this change.¹ Willis accused the immoderate use of sugar of having contributed to the increase of scurvy. Ray also subscribes to these opinions, and adds that sugar is very hurtful to the teeth, and not only renders them black, but causes them to decay and loosen in their sockets, and to fall out. Of all these opinions concerning sugar, the last is one of the most general and settled. Even Geoffroy, while lauding the lenitive and expectorant qualities of sugar when used medicinally, and its advantages when duly mixed with the food, echoes this objection to its free employment, adding what is now popularly believed, that it promotes the generation of worms, and that it creates flatulence and bile, and destroys the appetite.

Rumphius states that the first person who employed sugar in pharmacy for the preparation of confections and syrups, was Actuarius, who lived in the 11th or 12th century.

ACTION OF SUGAR.—Sugar is generally regarded as nutritious food, as contributing directly to the growth of the tissues, and especially to the formation of fat. The sleek condition of the negroes in sugar producing localities during the cane harvest, is cited in support of this belief. But the negroes consume cane juice, and not sugar; and the former contains a number of saline constituents and azotized matters which are not present in the latter. Böcker, who has carefully examined the question, shows that sugar is not directly a fat-producing substance,² and that it cannot possibly contribute anything to the nitrogenous tissues. Consequently, he concludes that it cannot be regarded as nutritious.

In this connection the well known experiments of Magendie, and

¹ MOSELEY, op. cit., p. 86.

² Op. cit., p. 163.

of Tiedemann and Gmelin, may be referred to, for they show that animals fed entirely upon sugar perish in from two to four weeks, with all the evidences of exhaustion and atrophy. The experiments of Dr. Stark are of the same import. A diet of bread and sugar exclusively, produced in him a scorbutic state of the system, with swollen gums, ulcers of the mouth, purple blotches on the skin, and diarrhœa. It is usually stated that he fell a victim to his imprudent devotion to the cause of science, and he certainly earned a martyr's crown by his self-sacrificing zeal; but the examination of his remains revealed the characteristic lesions of typhoid fever.¹ It is a familiar fact that, in general, persons who consume a large quantity of sugar in the shape of confectionery, lose their appetite, suffer from heartburn, gastralgia, and acid eructations, grow pale and thin, and are subject either to constipation or diarrhœa.

Böcker has shown that sugar, when freely used, diminishes the amount of solid excreta in the urine, or, in other words, lessens the waste of the system in this direction. By the same mode of action it diminishes the amount of carbon and also of oxygen and water in the expired air. Its part, therefore, as an article of food is that of a respiratory element presenting itself to the inspired oxygen as a substitute for the tissues themselves, and thus limiting the waste of the body while it sustains the animal heat. The appetite for it displayed by children appears to be a natural instinct, the object of which is to enable the system to appropriate for the growth of the organs azotized food which would otherwise be consumed in the production of animal heat.

The power of sugar to allay thirst was known to the ancients, as already has been mentioned; it was also noticed by Stark, and has been illustrated by Böcker.

It is a general belief that sugar when eaten freely injures the teeth. But Moseley says, "This has long been known as a prudent old woman's bugbear, to frighten children, that they might not follow their natural inclination by seizing opportunities, when they are not watched, of devouring all the sugar they can find." Böcker particularly remarked the pain experienced in the teeth on chewing sugar, and he refers to the experiment of Larrey, who found that sugar enters into combination with the earthy elements of the teeth. By immersing a tooth in a concentrated solution of sugar, it became soft, and the enamel was readily crushed. In spite of some notable examples to the contrary, we apprehend that the injurious action of sugar upon

¹ DUNCAN'S Commentaries, xiii. 166 and 175.

the teeth cannot fairly be called in question, although an experiment of Plenck is recorded which contradicts that of Larrey. Plenck immersed a sound tooth for two months in syrup diluted with water, and at the end of that time it was completely unaltered.¹ Oesterlen, also, after repeated trials, found no such effect as that reported by Larrey. It is, however, prudent, after eating sugar, to rinse the mouth well with water.

USES.—Although of comparatively small utility for its separate medicinal effects, there are few agents more useful than sugar as an associate of other medicines. In solution it appears to be exclusively lenitive, but in the pulverulent form it exerts a stimulant action.

In all irritations of the mucous membrane of the fauces and the air-passages, it is universally employed to allay irritation and mitigate cough and hoarseness. This it appears to do in the case of the throat and larynx partly by its protective influence, and partly also by its increasing the mucous secretion of these parts, and that of the salivary glands. Hence it is peculiarly an appropriate remedy for that tickling sensation which so often excites distressing paroxysms of coughing. Sugared water is said to have produced a curative diuretic effect in some cases of dropsy. It is habitually used, as above remarked, to promote digestion, and, it may be added, to allay nervous excitement. According to some writers sugar manifests anaphrodisiac powers.

The influence of sugar in retarding oxidation of the tissues appears to suggest an explanation of the universal use of this substance in febrile affections as the usual condiment of all mucilaginous, farinaceous, and gelatinous substances employed in those diseases. It is, however, liable to the objection that if too freely used it becomes acid in the stomach and bowels, impairs the digestion, and induces diarrhoea and flatus.

The quality of sugar just referred to has been applied in the treatment of diabetes mellitus, a disease in which the waste of the solids is more excessive than in any other affection. Andral had shown that an entire exclusion of saccharine and amylaceous food does not by any means prevent the formation of sugar in diabetes, and Bernard discovered that the liver is capable of converting nitrogenous as well as amylaceous substances into sugar. Mr. Priehard suggested that a treatment might be beneficial which would supply the loss of the saccharine principle, and M. Pierre having used sugar successfully in a case of diabetes, Mr. Budd administered this substance to a patient whom he had under treatment in 1857, and who was then extremely

¹ STRUMPF, Handbuch, i. 165.

feeble and emaciated. Although, at first, the amount of sugar in the urine was not lessened, the patient improved in flesh and strength, the urine diminished greatly in quantity, and its density fell from 1044 to 1034. The diet used at the same time consisted of bread, butter, eggs, and mutton chops.¹ Dr. Corfe also reports the history of a case which was apparently almost cured by abstinence from farinaceous food and by the use of sugar candy and honey.² Dr. Williams, on the other hand, has published the cases of two persons who, under the ordinary treatment, had ceased to lose flesh. In both cases the saccharine diet increased the quantity and the specific gravity of the urine, and produced rapid emaciation. A similar instance of the failure of this treatment is published by Dr. Burd. His patient was excessively reduced by diabetes, and the saccharine treatment produced a still more rapid exhaustion. A like result was obtained by Dr. Bence Jones; his patient declining in weight while the quantity of sugar in the urine increased.³ On the whole, therefore, it would appear that experience has only disappointed the hopes that were once entertained of finding in sugar a certain palliative, if not a specific, for diabetes.

Finely-powdered sugar is said to be a remedy for the hiccup which nursing infants are subject to from overfeeding.⁴ It is also a very efficient application for the cure of aphthæ of the mouth; it is useful in repressing the exuberant and flabby granulations of ulcers; as a stimulant for removing opacities of the cornea; and in chronic laryngitis when inhaled by a sudden aspiration from a quill or other tube extending from beyond the lips to the fauces. It has also been used as a sternutatory, and for diluting more active powders intended for application to the nasal passages. The fumes arising from burnt sugar have the property of destroying offensive effluvia, and are familiarly used in the sick chamber for this purpose, powdered sugar being strewn upon hot coals or a piece of heated iron.

In pharmacy sugar is extensively employed to prevent the decomposition of vegetable substances (conserves, confections), and the oxidation of metallic preparations, as in the case of the syrup of the iodide of iron. It forms the excipient in many magistral and officinal preparations, such as powders, pills, and lozenges; in the form of syrup is also the excipient of an entire class of officinal preparations (*Syrupi*), and is added to many extemporaneous prescriptions for the purpose either of masking a disagreeable taste or of suspending an insoluble substance in water.

¹ RANKING'S Abstract (Am. ed.), xxvii. 96.

² Times and Gaz., Sept. 1858, p. 292.

³ Times and Gaz., May 1, 1858.

⁴ SCHNELLER, *Arzneim. des Kindlichen Alters*, p. 17.

CLASS II.

ASTRINGENTS.

ASTRINGENTS have been defined by Cullen to be "such substances as, applied to the human body, produce contraction and condensation of the soft solids, and thereby increase their density and cohesion." Boerhaave describes them as medicines "which cause the parietes of the bloodvessels to approach one another, close these tubes when open, increase the strength and rigidity of the fibres, and restore their firmness to relaxed tissues." This latter definition refers to an operation implied by the term *styptic*, which is commonly employed to designate medicines that control hemorrhage; but the words astringent and styptic are identical in original signification, the one being a Latin and the other a Greek expression of the same idea.

Astringents are derived from the vegetable and from the mineral kingdoms. Those of the former class agree in containing tannic acid associated with various bitter and other principles, while the latter consist chiefly of metallic salts.

The difficulty of explaining the *modus operandi* of medicines is nowhere more manifest than in what relates to this, one of the simplest of the classes into which they are divided. No effects are more evident and tangible than those of astringents, but none are less understood. When an astringent substance is taken into the mouth, it instantly causes a sensation of constriction and puckering of the tongue, lips, cheeks, and gums, a sensation so familiar and so primary in its nature, that no other word describes it so well as *astringency*. With this sense of puckering is associated one of stiffness and dryness of the affected parts, and, if the preparation be a strong one, as a concentrated solution of tannin, it operates as an irritant, occasioning pain. The latter effect is more marked when the application is made to the mucous membrane of the eye or of the nasal fossæ, and is followed by a profuse secretion from the adjacent membrane and from the lachrymal glands. When astringents containing tannin are taken into the empty

stomach, and in large doses, they are apt to occasion nausea and eructation, and the tongue becomes coated. If the sensibility of the stomach is morbidly increased, pain may ensue, and as experiments upon animals prove, even a caustic effect may result. When these substances are administered during the process of digestion, it is materially interfered with in consequence of the precipitates which they form with albumen, casein, and the gastric juices. Their ulterior influence upon the stomach displays itself in impaired appetite and digestion, gastric pain and even vomiting, and, as a consequence of these effects, emaciation and debility.

The generally received opinion is that astringents produce constipation, but, although they certainly diminish the secretions of the intestinal canal, they do not appear to diminish the peristaltic movements of the bowel. Such was the result of Hennig's experiments upon himself, on cats, and on frogs,¹ and, although Cavarra, as elsewhere stated, asserts that tannic acid in doses of two grains and a half produced obstinate confinement of the bowels, Dr. Tully declares that he took ten grains of pure tannic acid four times in the twenty-four hours, and continued these doses about a week, with no more constipating effect than if he had taken so much maize meal.² A similar trial with identical effects was afterwards made by several professional pupils of Dr. Tully. The article excited a little nausea, however, and impaired the appetite considerably. This distinguished physician also assures us that he often administered tannic acid in doses of a heaped teaspoonful, at short intervals, till it began to disturb the stomach, in cases of hemorrhage from the lungs, for example, and without any constipation as its effect. It may be objected (and the objection appears to be not without weight), that in these experiments the quantity of the medicine taken was sufficient to irritate the bowel, and thus to neutralize, or more than neutralize, the desiccative operation of the former. This appears the more probable, since we find that no mention is made of dryness of the dejections, such as Cavarra, and also Hennig, invariably found.

The manner in which the constringing and drying operation of astringents is performed, is not regarded in the same light by all who have examined the subject. According to some, it is explained by the coagulation of albumen, which all astringents produce, and the precipitation of gelatin which is strikingly effected by tannic acid. But such processes cannot be supposed to take place in the living

¹ Archiv. für Wissenschaft. Heilkunde, i. 697.

² Materia Medica, or Pharmacology, i. 1112.

body. Mr. Headland, recognizing the validity of this objection, assumes that astringents act directly and especially on muscular fibre, causing this "to contract, whether it be striped and voluntary, or of the involuntary unstriped kind."¹ Taken into the blood in a state of solution, he supposes them to pass through the walls of the capillaries to the muscular tissue, and to stimulate to contraction the unstriped muscular fibres existing in the middle coat of the arteries, in the walls of the capillary vessels, in the lining of the ducts of glands generally, in the substance of the heart, and in the coats of the stomach and intestines. It need hardly be said that this view, however well it may be adapted to explain the phenomena occasioned by astringent medicines, is a purely gratuitous theory, and might be predicated of tonic, or, indeed, of other classes of medicines, as well as of astringents. In regard to mineral astringents which evidently exert their power of coagulating albumen and fibrin, when applied upon secreting or bleeding surfaces, it is quite as difficult as in the case of tannic acid, to understand in what manner they can retain an astringent power while passing through the blood. We do indeed know, that in some manner this power is retained, for we constantly see it exercised by the acetate of lead, the salts of iron, &c. But to suppose, with the author just quoted, that these substances "are constrained by various forces" to suspend their natural tendencies so long as they are in the blood, and that on their exit by secretion from this fluid, they resume their original activity, is simply to substitute an hypothesis for an inductive law, and, perhaps, to deter from investigation where inquiry is most needed.

In regard to the local action of astringents, there is much plausibility in the view which is taken by Hennig. This experimenter remarks that a strong solution, or a powder of tannic acid does not impress the nerve of taste in as great a degree as a weaker preparation, because this latter penetrates the epithelium, and therefore affects the gustatory nerve more readily. The sense of astringency he ascribes to the strong affinity of the astringent substance for water, which, therefore, it abstracts from the membranes and papillæ, corrugating the superficial layers of the epithelium, and causing them with "the parasitical capillary fungi" on their surface, to be thrown off. Hence the more newly-formed epithelial layers are laid bare, and, if the tannic acid is renewed, it penetrates and desiccates the subjacent tissues. Hence, also, instead of being stimulated, the muscular layer is deprived of its freedom of movement, and becomes stiff. At the same time the

¹ The Action of Medicines, p. 244.

surface to which the solution is applied, loses its polish. If a very strong solution of tannic acid is used, the sense of taste may be temporarily quite lost, the nervous substance be disorganized, and the mucous membrane likewise; but the very energy of this action limits its extent; the constriction of the superficial parts is so great, and their hardness is so much increased by the coagulation of albumen interstitially effused, that the penetration of the astringent liquid is arrested.

Considering the results of experience in the use of tannic acid, there appear to be good grounds for doubting its efficacy as an astringent except when it is locally applied. Otherwise it is certainly inferior to the mineral astringents. Nor is there any reason for attributing to it a tonic property which some have done from witnessing the effects of certain vegetable medicines which yield this substance; for such medicines also contain bitter principles upon which, doubtless, their tonic properties depend. It does not follow that pure tannic acid is always to be preferred for internal administration as an astringent. On the contrary, the tendency which it shows to derange the digestive function, suggests the propriety of prescribing it in its natural associations with bitter tonics whenever a prolonged use of it is required.

Each of the several astringents has powers which are peculiar to itself, and they can by no means be substituted for one another so as to produce identical effects. Nitrate of silver and sulphate of copper excel vegetable astringents in consolidating ulcerated tissues, but preparations of tannin, or rather of some of the astringent barks, are far superior to these mineral remedies in preventing that softening of tissue which tends to terminate in ulceration. The first named articles are also better adapted, as a general rule, for internal administration. Creasote, nitrate of silver, nitric acid, and other strong acids, are more efficacious as styptics than tannic acid. Except creasote, these are also caustics. Several astringents possess likewise specific powers of a totally different nature. Lead, for example, in some of its forms, has a special direction to the nervous system, and in another constitutes a powerful deodorizer. Iron, which in certain of its combinations, as the perchloride, is eminently a styptic, is a tonic in its general operation. The sulphates of alumina, copper, and zinc, are emetic as well as astringent, and the second is supposed to have some antiperiodic influence, while the last is employed in the treatment of neuralgia.

From the above statement of the operation of astringent medicines it will be inferred that they have been found useful both internally and externally, whenever a simple laxity of tissue exists, or at the same time favors an undue discharge of blood or other animal liquid,

or when this or a more active cause occasions its stasis within the affected part.

External Use.—Relaxation of tissue is a frequent consequence of debility either original or acquired. The former is observed in young persons of a lymphatic constitution, and especially in females, and is manifested by weakness of the joints, swelling of the ankles, a pendulous condition of the mammæ, and a general flabbiness of the skin. In such cases general baths and lotions containing vegetable astringents have been found to impart tone to the enfeebled tissues. Gargles or lotions of the same composition are in common use to correct atonic œdematous swelling of the fauces, or simple relaxation of these parts, of the vagina, or of the rectum; or else the more powerful stimulus of mineral astringents is resorted to for the same purpose. A tendency to passive inflammation and gangrene of the skin, subjected to pressure by the posture of the patient or otherwise, is often met with in protracted sickness with great debility, and such effects may sometimes be guarded against by hardening the integument by means of the substances in question. Or if disorganization have already commenced in the case alluded to, or if, from other causes, such as an epidemic influence, accidental wounds, or wounds made by the surgeon's knife, betray a tendency to gangrene, the desiccative power of astringents, and especially of powdered cinchona or oak bark, is immediately manifested, the affected parts become firmer, and their offensive odor is neutralized. The pulverulent form of the application is not without its influence. In these cases, also, some medicines ranked usually with astringents, such as creasote and nitrate of lead, produce a powerfully deodorizing effect.

Astringent medicines are powerfully antiphlogistic in their local operation. Inflammation implies congestion and effusion, and astringents, by their action upon the tissues, exclude the blood, and consequently prevent the ulterior changes which its presence would induce. But it is essential to the success of this operation that it should not be interrupted; for at every suspension of its repressive action the blood rushes with augmented force into the irritated part, and resists the power of the medicine to dislodge it. Hence, in the forming stage of inflammations, unless the astringent action can be steadily sustained, it had better not be invoked at all. It is, therefore, an ineligible mode of treating the first stage of local inflammation involving the eye, the fauces, and in fact any of the accessible mucous membranes. Indeed, even if the astringent substance could be maintained in these situations, it would generally be found that the morbid sensibility of the part would be aggravated by its contact. It

is true, however, that when such applications are made at a low temperature, this effect is modified, and may even be neutralized, especially if the contact with the inflamed tissue is not immediate; as when compresses wet with lead water, or when alum curd is applied over the eyelid in the forming stages of conjunctivitis. It is in purely local inflammations of parts covered by the skin, and above all in those of a traumatic origin, that astringent lotions are most useful, and especially in sprains, contusions, &c., provided the application be made directly after the injury. In this case the morbid process may be arrested in its forming stage; but when once effusion has taken place the measures in question tend only to prolong and even to perpetuate the debility of the part, because they impede the curative operations of nature in removing the effused and now consolidated liquids. In the decline of the inflammatory process, however, when active movements have ceased, and the parts are affected with atony rather than excessive action, astringents may be appropriately resorted to for the purpose not only of consolidating the relaxed tissues, but also, in some cases, by a direct stimulant action, of promoting the absorption of the effusion, and thus restoring the part to its normal dimensions and activity. Some care must be exercised, however, lest the prolonged use of these measures should interrupt the nutrition of the tissues, and induce their atrophy.

But there are many cases in which inflammation of the integument, or of the subjacent parts, is neither traumatic, nor, even when spontaneous, strictly local. There are many eruptions of the skin which are signs of an internal and constitutional disorder, and are even indications of an attempt on the part of the economy to rid itself of some noxious ingredient of the circulating fluid. Syphilitic eruptions are of this sort, and are never benefited by a repulsive treatment. The same is true of all the exanthemata. Repressive means are, perhaps, never attempted in any of these, except erysipelas; but even in this affection the method is full of danger. Even in those diseases of the skin which are not specific, but yet which are often dependent upon some hereditary or acquired vice of the economy, it is seldom desirable to attempt a cure by the means in question, for, apart from its probable failure, it is exposed to the risk of arresting the external disease at the expense of some internal organ more essential to life than the skin. The latter remark is quite as applicable to the question of curing an ulcerated surface which has long furnished a purulent discharge. To do so is never free from peril, and it is peculiarly hazardous when the patient is of a plethoric constitution, or inherits a tendency to apoplexy, phthisis, or other serious internal disease.

Amongst the occasions for an external use of astringents must be mentioned hemorrhage, both spontaneous and traumatic. But while the former, depending as it does, either upon the constitution of the blood, or upon the energy of the circulatory forces, is comparatively less amenable to local influences, the latter is often maintained either by the nature of the wound or by other causes not so appreciable. It is in this, however, that styptic applications are of the greatest use, by coagulating the blood even within the bleeding vessels, and thus gradually arresting their loss. It should not be forgotten that the operation of the styptic ought always to be sustained by mechanical means.

Internal Use.—It has already been seen that astringents are constantly employed as local agents to correct debility and laxity of the external integument, and of the mucous membrane immediately connected with it. They are scarcely less frequently resorted to in analogous conditions of the lining membrane of the gastro-intestinal canal, and even of the urinary organs and other parts that are most conveniently reached through the channel of the circulation.

Astringent medicines are of common use in the treatment of gastric debility accompanied with indigestion and flatulent distension of the stomach and bowels, but seldom or never in their state of pure astringency. Tannic acid, so far from exerting a beneficial influence on such conditions, tends only to aggravate them; but when this substance, in its natural association with bitter tonics, is appropriately administered, the tone of the affected organ is gradually restored. Even in that disorder known as gastrorrhœa, or gastric flux, a pure astringent is of little avail, while a medicine that is stimulant and tonic, as well as astringent, is most appropriate to the cure. Indeed, it appears to be very probable that whatever benefit may accrue from the use of mere astringents in chronic gastric disorders, is more than counterbalanced by the mischief they occasion in preventing a due secretion of the acid juices of the stomach and of the bile, fluids which are essential to good digestion. The more common disorder, intestinal flux, is very often treated by means of astringents, and often very improperly. Diarrhœa is nearly always due to one of the following causes, irritants in the bowel, inflammation or other disease of this latter, or a depurative operation for the elimination of some morbid element from the economy. Of these causes the only one which tolerates the use of astringents for curing the resulting diarrhœa, is a form and degree of inflammation unaccompanied by any active symptoms such as pain, tenderness, and fever. To administer these medicines when the intestine contains irritating ingesta, or when the flux tends to

relieve congested organs, or when the blood is charged with effete and poisonous materials, is to prolong disease and even to endanger life. In the first of these cases astringents become safe remedies only after the bowels have been purged of their irritating contents, and even then those forms of administering them are best in which they are associated with aromatic stimulants or with opium. In the other affections referred to, astringents are never useful during the active stage, unless it be to check an excessive evacuation of the fluids, and even in that case opiates are usually to be preferred. In the treatment of ordinary cholera, the latter remedies are infinitely more efficient than the former, and usually suffice to effect a cure. Even in epidemic or pestilential cholera, when fully formed, the only astringents which appear to be at all useful are mineral acids and the acetate of lead, and these, as it has been already remarked, are far from exercising a simply astringent operation. But these medicines, except in the decline of the attack, are of comparatively slight utility, and their failure to cure, even when their operation is most manifest, proves that in modifying a symptom of the disease they leave its essential virulence unabated. In dysentery, which on several grounds appears to be more than a simple inflammation, astringents are often administered imprudently, with the effect of directly aggravating the disease; or, if they do not inflict this injury, they tend to establish an irritation of the bowel, indefinitely prolonged by their promoting the formation of scybala. These remarks, which are true of simple astringents, are somewhat less applicable to acetate of lead, which, on account of its sedative action, is not contraindicated by the febrile symptoms of the disease. Yet the condition of the fecal matters just alluded to results from the use of this as well as of the other remedies of the same class, and ought therefore to be guarded against by avoiding the premature or the too lavish use of the preparation in question.

In *passive hemorrhages*, due either to a diseased condition of the blood, or to an atonic state of the solids generally, or of some particular organ, astringent medicines are frequently employed, and with signal advantage. It is true that they may not, and the pure astringents certainly do not, permanently counteract the cause of the hemorrhage, but it is often an important object to check the loss of blood and failure of the strength, until the remote cause of the hemorrhage is removed by appropriate means. The modes by which astringents fulfil this indication are probably various; some, and those of vegetable origin in particular, appearing to act rather by a constricting influence upon the capillary bloodvessels than by any direct modification of the blood; others, as the muriated tincture of iron, and still more, the

perchloride of that metal, certainly produce coagulation of the blood when it is discharged; the acetate of lead seems to exert a coagulating power indirectly by its sedative action on the heart, as is seen in the treatment of aneurisms by its use. If we admit, however, that astringents are capable of coagulating the blood within the vessels, it is difficult to understand why they should exert this power upon the particular bloodvessels which are the seat of hemorrhage, and not equally upon all those in the body. That they have not this latter effect is evident, because it would be incompatible with life. To suppose, as is commonly done, that these medicines increase the coagulability of the blood, is an assumption not founded upon sufficient facts. Indeed, all that we know of their direct influence upon the blood is inconsistent with this supposition. Mitscherlich, having partially immersed frogs in a solution of tannic acid, so that their blood became impregnated with it, found that the circulating fluid grew darker in color, coagulated more slowly than usual, and formed an imperfect and pasty clot. So far as this experiment, which was also performed by Hennig, may be regarded as authoritative, it expressly discredits the belief that astringents exercise any condensing power on the solid constituents of the living blood. It is more consonant with experience to conclude that, when given internally, they control hemorrhages by the constringing influence which they exert upon the solids.

In this manner also, it is conceived, astringent medicines are sometimes useful in moderating fluxes from the skin, lungs, kidneys, bladder, and uterus. It is worthy of remark that pure vegetable astringents (tannic acid) are most potent in controlling colliquative sweats; they are less so, yet not inoperative, in chronic bronchial flux; while in most of the other cases mentioned, mineral astringents are decidedly to be preferred. Yet, in catarrh of the urinary organs, several vegetable astringents (*uva ursi*, *pipsissewa*) are used with advantage, in all probability, because in them the astringent principle is associated with a stimulant, or a saline ingredient, which renders the medicine diuretic.

FRIGUS.—*Cold*.—Vid. *General Sedatives*.

MINERAL ASTRINGENTS.

ACIDA MINERALIA.—*Mineral Acids*.—Vid. *Irritants*.

ALUMEN.—ALUM.

DESCRIPTION.—Alum is a sulphate of alumina and potassa, consisting of one equivalent of each of these salts, and twenty-four equivalents of water. It occurs native in the neighborhood of some volcanoes, and in coal formations, but is usually the product of the direct combination of its elements, or of the calcination and lixiviation of alum stone, a mineral formed in lavas and trachytic rocks by the rise of sulphurous vapors. It is also obtained by exposing to heat and air an alum slate or alum earth, in which the bisulphuret of iron is converted into an oxide of iron, and sulphate of alumina is formed, which, on being lixiviated, combines with the sulphate of potassa in the ashes of the solution, and alum is produced.

Alum crystallizes in octohedral crystals and sometimes in cubes, but, as usually found in commerce, it is in irregular masses with an obscurely crystalline surface. It is transparent or translucent, effloresces slightly, is inodorous, and has a strongly styptic and astringent taste. On being heated, its water of crystallization is given off with fusion of the mass and ebullition, and a white dry spongy mass results which is called *burnt alum*, and is styptic in a high degree. This preparation is officinal under the name of *Alumen exsiccatum*, or *dried alum*. Alum dissolves in eighteen times its weight of cold, and less than its own weight (0.75 parts) of boiling water, and is very slightly soluble in alcohol.

HISTORY.—Beckmann has attempted to show that *στυπτηρία* of the Greeks, or its equivalent, *alumen* of the Romans, was not our alum, but rather a sulphate of iron, copper, or zinc. He is of opinion that alum was first brought into Europe from the East in the twelfth century, and that the oldest alum works in Europe were established about the middle of the fifteenth century.¹ Mr. Adams, however, dissents from

¹ Hist. of Inventions, 2d ed., i. 288.

this opinion, on the ground that as alum abounded in Greece and Italy, it must have been known to their inhabitants, and it is not pretended that it was ever called by any other name. Other writers entertain similar views.

Three varieties of alum (*στυπτηρία*) are distinguished in the Hippocratic writings, where a solution of it in white wine with pomegranate skins is recommended as an enema, and for preparing a suppository for prolapsus ani; a cataplasm containing it and moistened with vinegar, is advised for irritable, inflamed, and sordid ulcers, and burnt alum in ulceration of the womb.¹ Dioscorides describes three varieties of alum. He says that it is heating and astringent, represses fungous granulations, stanches hemorrhages, hardens spongy gums, with honey cures ulcers of the mouth, is useful in otorrhœa, and dissolved in an infusion of cabbage, or mixed with honey, is beneficial in various cutaneous affections. It is of service to reduce all swellings of the gums, tonsils, and soft palate, and is applied with honey to the mouth, the ears, and the genital organs.² Celsus makes several allusions to alum, as an application to ulcers produced by cold, and to fistulous sores, and as an escharotic for certain tumors (*myrmecia*) of the hands and feet.³ To this account given by his predecessors, Pliny does not add much, except that alum acts internally as a hæmostatic, and that it is used in enema for the cure of dysentery.⁴ The native practitioners of India prescribe alum occasionally in cases of chronic diarrhœa, diabetes, and fluor albus, and externally in ophthalmia.⁵ Aretæus particularly recommends in malignant sore throat, that powdered alum should be blown upon the ulcerated part through a quill or reed, or applied mixed with honeyed water.⁶ He recommends it, also, for internal hemorrhages, and to arrest bleeding from the nose. Alum is said also to have formed a principal portion of the treatment for the epidemic malignant anginas, which prevailed in Europe from the end of the sixteenth to the middle of the seventeenth century.⁷

ACTION.—The primary local action of alum is that of an astringent; it turns the part pale to which it is applied, by producing a contraction of all its fibres, including those of the bloodvessels, and, in the case of mucous membranes, it also renders them dry by diminishing their secretion. In this manner its direct action upon the intestinal canal is productive of constipation. According to Mitsherlich, and also Mialhe, a chemical action then ensues, and the alum enters into

¹ Mat. Med. of Hippocrates, DIERBACH, p. 246.

² Mat. Med., lib. v. cap. lxxxii.

³ GRIEVE'S CELSUS, 3d ed., p. 276, 281, 285.

⁴ Hist. Nat., lib. xxxv. cap. lii.

⁵ Materia Indica, i. 11.

⁶ Works, Syd. Soc. ed., pp. 409, 423, 460.

⁷ BRETONNEAU, Arch. Gén., xiii. 14.

combination with the secretions of the part, and ultimately, if these fail, with the tissue itself, upon which it then acts as an irritant or caustic. If this action is sustained and prolonged, the ultimate effect of the medicine may be to increase the secretion of the part instead of diminishing it. Such an effect is familiarly observed when alum is administered internally; it soon ceases to confine the bowels, and, indeed, as will be seen hereafter, it is actually used to overcome one of the most obstinate forms of constipation, that which depends upon lead poisoning. Mialhe refers to an example of the same sort furnished by the treatment of leucorrhœa with alum injections. Moreau states that these at first diminish the discharge, but if they are strong and long continued, they increase it. Mialhe mentions the case, also, of a person in whom the continued use of alum gargles induced copious ptyalism, and he thus endeavors to explain the effect. "When a very small quantity of alum, either in solution or not, is brought into contact with a mucous membrane or the denuded cutis, it is decomposed by the alkaline liquids of the part, forming a subsalt of alumina and potassa, and producing coagulation and constriction. But if a larger quantity of alum is now employed, not only is the original coagulum dissolved, but all the albuminous liquids of the economy, which have become saturated, as it were, with alum, become so fluid as to pass readily through the tissues which are now no longer constricted. If, then, we desire to exert only a constringing action upon a part, we should use but a small proportion of alum; but if, on the contrary, we seek to increase the activity of a part and render the humors more fluid, the medicine should be applied in large quantities."¹ In this chemical explanation of the increased discharge which follows the long continued application of alum to a secreting surface, its irritant action appears to be overlooked, and this, it may fairly be presumed, by repetition excites the discharge in question.

The familiar facts of practical medicine render it certain that when alum is taken into the stomach it is absorbed, and modifies the blood, and probably, also, the contractility of the animal fibres. But it is also found in the urine of persons who use it, and in the liver, spleen, and other organs of animals to which it has been given in large quantities.

It appears from Orfila's experiments, that the smallest and the feeblest dogs have taken enormous doses, even two ounces, of calcined alum without any other symptoms than vomiting and purging; but if vomiting is prevented by ligation of the œsophagus, the animal dies

¹ *Chimie Appliquée*, p. 258.

in a few hours, after exhibiting great debility and prostration. In the case of rabbits, used by Mitscherlich in his experiments, the result was different; two drachms of alum in solution proved fatal. In all the experiments which terminated fatally, the mucous membrane of the stomach was strongly inflamed, and in some cases erosions existed.

In man large doses of alum produce a sense of constriction in the fauces, and an unpleasant sensation in the stomach followed by vomiting, and sometimes by colic and diarrhoea. A drachm is usually sufficient to produce vomiting in a child under five years of age, but much larger doses have been taken as a remedy for intermittent fever, or otherwise, by adults without any other effect than transient nausea. There is no case on record of death, or even of material inconvenience from the internal use of this medicine, in any dose, by a person previously free from serious disease. It is very possible, however, that if from insensibility, or any other cause, the alum were not vomited, it might occasion grave lesions of the stomach.

USES.—*Internally*.—Alum has probably been more employed for its styptic qualities than on any other account. Both ancient and modern physicians have recognized them. Even the sceptical Cullen admits that he often found it useful in menorrhagia and other uterine hemorrhages, but not in hæmoptysis, which exception he explained by saying that the latter is usually active while the former are more frequently passive.¹ It would have been more exact to state that alum, like every other hæmostatic medicine, is most useful when the *molimen hæmorrhagicum* is feeble, than when it is strong, for as such medicines arrest hemorrhage by creating a physical barrier to the escape of the blood, they are necessarily more efficient when the tendency of the blood to escape is feeblest. In hemorrhage from the *stomach*, the effects of the medicine will depend much upon the source of the effusion. If it be a passive exudation, the direct operation of the alum must be beneficial; if an active discharge from the erosion of a bloodvessel, or otherwise, the combined emetic and styptic action of the medicine would appear to be peculiarly indicated. In hemorrhage from the *bowels*, the tendency of large doses of alum to act upon the whole intestinal tract renders it more appropriate than the metallic sulphates. It has been found efficient in *hæmaturia*, whether the bleeding had its source in the kidneys, the ureters, or the bladder. In some forms of blood disease it has been used with advantage to prevent hemorrhage. Thus, Mead recommended it alternately with Peruvian bark and sulphuric acid in the hemorrhagic form of smallpox.²

¹ Mat. Med., ii. 18.

² Works, p. 245. See, also, Dobb, Phil. Trans. Abridg. ii. 465.

A Dutch writer, J. Grashuis, is said to have first recommended the use of alum in *colica pictonum*. He published several examples of its beneficial effects. In imitation of him, Pereival also administered it "in the slighter cases" of the disease, prescribing fifteen grains of alum every four, five, or six hours. The second or third dose, he says, seldom failed to mitigate the pain.¹ Various other persons have commended this plan of treatment, especially Kapeler, who maintains it to be more efficient and prompt than the purgative plan,² and Gendrin, who declares that in fifty-eight cases of painters' colic the remedy did not fail once.³ Dr. Copland, who witnessed, and who vouches for the success of Kapeler, states that he has employed alum with uniform success in several cases;⁴ and Brachet, in 1850, reported that, after becoming dissatisfied with the old methods, he had recourse to alum, and treated with it more than a hundred and fifty patients without accident or disappointment. He prescribed from $1\frac{1}{2}$ to 2 drachms, in a ptisan, to be taken during the day, adding to this 40 or 50 drops of laudanum, and if the bowels did not act by the third day, giving a mild aperient.⁵ Yet more recently, Briquet, who treated fifty-seven cases, in the course of eight years, with alum and sulphuric acid, found that by this method the duration of the pain was nearly the same as in the treatment by purgatives, while the constipation continued somewhat longer. The convalescence, on the other hand, was more rapid. His method consisted in the daily use of two quarts of sweetened water containing a drachm of sulphuric acid, and also a drachm of alum dissolved in gum-water. A grain of opium was prescribed at night, and sulphurous baths daily for as long as they continued to stain the skin.⁶ It should be mentioned that neither Tanquerel nor M. Grisolle attributes any great degree of efficacy to the alum treatment; but the proofs of its virtues which we have furnished are, we think, conclusive. The dose of powdered alum is from one to three drachms a day, given in solution.

Another evidence of the value of alum in an analogous affection, is furnished by Mr. Aldridge's experience with it in cases of *habitual constipation*, producing or produced by atony of the intestines. In the dose of one or two scruples he found that it would often produce large and very solid evacuations. Associated with sulphate of magnesia it corrects the unpleasant taste of this salt, and its tendency to produce flatulence.⁷

¹ Essays, i. 401, 459.

² Arch. Gén., xviii. 370.

³ Compend. de Méd. Pratique, ii. 427.

⁴ Dict. of Pract. Med. (Am. ed.), i. 440.

⁵ Br. and For. Med.-Chir. Rev., Jan. 1851, p. 46.

⁶ Bull. de Thérap., liii. 97.

⁷ BRAITHWAITE'S Retros. (Am. ed.), xii. 82.

Dr. W. Griffin, of Limerick, found alum superior to all other internal remedies for *gastralgia* in cases of this affection associated with neuralgia of the spinal nerves.¹ Sir J. Murray made use of it with complete success to cure the affection described by him as *catarrh of the stomach*, in which the patient vomits large quantities of glairy and viscid mucus. For this disorder he prescribed alum in the form of an electuary, in doses of about ten or twenty grains, three or four times daily.²

In chronic *dysentery* alum has sometimes been used. With sulphate of zinc, cochineal, and water, it formed the vitriolic solution, of which Moseley said he pledged the experience of many years that it was the best remedy he was acquainted with in this and similar affections.³ A case of chronic dysentery was cured with alum by Dr. Leib, of Philadelphia, in 1789.⁴ But it has also been employed in acute dysentery. Adair states that he used it early and boldly, found it sedative and antiseptic, in a large dose laxative, and altogether the safest astringent he had tried.⁵ In the same form of the disease M. Hanon made use of injections of a solution of alum, each enema containing from ten grains to two drachms of alum, according to the age of the patient. He states that its administration promptly afforded relief, and was followed by a speedy cure.⁶

The astringent qualities of alum probably led to its being prescribed in the treatment of *diabetes*, first by Mead, and afterwards by Dover and Brocklesby, the last of whom reports a case apparently of the saccharine form of the disease, and which was cured by alum whey.⁷ Cullen, however, employed it without success.

It is well known that large doses of alum excite vomiting, and, as has been seen, when the œsophagus of an animal is tied after the administration of a large dose of alum, death ensues, and inflammation of the gastric mucous membrane is found on dissection. These irritant properties of alum might class it among the mechanical emetics along with the sulphates of copper and zinc. Dr. Charles D. Meigs, of Philadelphia, was the first to make use of this property of alum in the treatment of membranous and also of spasmodic croup, and his example has been followed by many practitioners of this city. In the latter disease a sedative influence rather than an expulsive effort is required, and hence the nauseant emetics are more beneficial in its

¹ *Révue Méd.*, xxxviii. 399; and *Observations, &c., on the Spinal Cord*. Lond. 1831.

² BRAITHWAITE'S *Retros.* (Am. ed.), xix. 313. ³ *On Tropical Diseases*, 4th ed., p. 401.

⁴ *Trans. College of Phys. of Philad.*, vol. i. 1793, p. 225.

⁵ DUNCAN'S *Comment.*, ix. 210.

⁶ *Bull. de l'Acad.*, xxii. 1011.

⁷ *Med. Obs. and Inq.*, iii. 279.

treatment; but in membranous laryngitis the strength of the patient must be taxed as little as possible, while medicines are given which excite the mechanical act of vomiting. Sulphate of copper is one of these, and has been used in a great many cases with the happiest result. Alum is probably next in value of the class of emetics referred to. Dr. J. F. Meigs says, respecting its use in true croup, that it possesses the advantages of being certain and rapid in its action, and of operating without producing exhaustion or prostration beyond that which always follows the mere act of vomiting. Dr. Meigs gives it in powder, in teaspoonful doses mixed with honey or syrup, and repeated every ten or fifteen minutes, until it operates. It is very seldom necessary to give a second dose to produce vomiting. It may be repeated twice or three times a day for two or three days, without any bad effect, and also with undiminished activity.¹ These are, certainly, strong inducements to the employment of alum in a disease so grave and alarming as membranous croup, especially as, in conjunction with mercurials, emetics must form the basis of the treatment. In those cases where we have used it, unhappily without ultimate success, its emetic virtues were signally displayed.

In other cases where a powerful emetic effect is required, and the use of sedative emetics involves danger, no agent is more efficient than alum. It seems to be peculiarly adapted for use in poisoning by narcotic substances. In a case in which an ounce of powdered opium had been taken two hours before, and thirty grains of sulphate of zinc had been given without producing emesis, half an ounce of powdered alum, followed by two or three tumblers of warm water, caused copious vomiting to take place. After a short interval, a like quantity of alum was administered, free vomiting was renewed, and the patient recovered.²

In *bronchial affections* alum is sometimes of signal advantage. This was long ago insisted upon by Moseley in describing the effects of his *vitriolic solution*.³ His language is so positive that we feel constrained to quote it. The solution, he says, "is of great utility in all pulmonic oppressions where respiration is performed with difficulty; and where expectoration is to be promoted, in nauseating or slightly vomiting

¹ Diseases of Children, 2d ed., p. 96.

² Dr. C. D. Meigs, Trans. of Col. of Phys. of Philad., N. S., ii. 47.

³ The formula for the solution is thus given: R.—Zinci sulph. \mathfrak{z} ij; aluminis \mathfrak{z} j; pulv. cocci gr. iij; aquæ bullient. Oj. Reduce the ingredients to a fine powder, and gradually add the water until they are dissolved. When cold, filter the solution. Dose.—To create a slight retching, for an adult, a tablespoonful; for a child, six months old, a teaspoonful.

doses. In most pituitous habits, with phlegmatic asthmas, in catarrhal coughs, and above all, in the moist English *hooping-cough*, its effects are wonderful; taken once or twice a day, particularly in the morning fasting, in doses to cause a slight retching. In the same manner it removes defluxions on the lungs, bronchia, and trachea, from relaxation of the parts, or defect of their powers."¹

It is not easy to understand why so efficient a remedy for an intractable complaint should have fallen comparatively into disuse. There are recent attestations of its efficacy, however, which may here be cited. As it has been seen, Moseley used and eulogized alum as a remedy for *hooping-cough* more than half a century ago. Subsequent authors, until quite recently, appear to have neglected it; but in 1844, it was recommended by Dr. Andrews and by Dr. Golding Bird.²

Dr. F. L. Andrews states that in acute as well as in chronic bronchitis, and both in children and adults, when the expectoration is ropy he used alum with the greatest benefit. To children three years of age he gave one grain in solution every five or six hours, and to adults six or eight grains at like intervals.³ It was by no means the intention of either of the gentlemen named to propose the medicine as a specific, but only as an appropriate and efficient remedy in the nervous or spasmodic stage of the attack, when there is a copious secretion of viscid mucus in the bronchia. Dr. Bird prescribed it extensively during a period of three years, and he declared that he had not met with any other remedy which acted so satisfactorily or gave such marked and often rapid relief. The formula used by him was the following: R.—Aluminis, gr. xxv; Extracti conii, gr. xij; Syrupi rhæados, ʒij; Aquæ anethi, ʒiij; m. capiat coch. i. med. 6tâ quâque horâ. It never produced any inconvenient astringent effects on the bowels; on the contrary, in more than one instance it occasioned some diarrhœa. Dr. Davis has also said: "After a long trial, I am disposed to attach more importance to alum as a remedy in *hooping-cough* than to any other form of tonic or antispasmodic."⁴ To these evidences of the efficacy of the medicine we may add that of Dr. J. F. Meigs, who, after administering it in sixty-eight cases, says: "It has exerted a more decided influence in moderating the violence of the disorder than any medicine that I have ever made use of."⁵ In a few cases in which we have employed it to lessen the bronchial secretion, it has appeared to

¹ Op. cit., p. 558.

² Guy's Hospital Reports, 2d ser., No. v. p. 139.

³ Lancet, March, 1844, p. 42.

⁴ Am. Journ. of Med. Sci., July, 1847, p. 218.

⁵ Diseases of Children, 2d ed., p. 223.

have a very decided and happy effect. Whether it shortens the disease as much as it mitigates its severity, is not yet, we think, determined.

Aphonia, depending upon atony of the larynx, as indicated by paleness of the fauces and debility of the pharyngeal muscles, has been treated with alum gargles with great advantage. Bennati, formerly physician to the Italian opera in Paris, found that a gargle, made by dissolving a drachm of alum in two ounces and a half of barley water, and gradually increased in strength, was of essential service in restoring the natural tones of the voice. He combined with this application, however, sedulous attention to the general health, and a regulated exercise of the voice.¹ Saucerotte found the internal administration of alum still more efficient than its use in gargles. He began by prescribing ten grains a day in divided doses, and gradually increasing the quantity to forty-five grains.²

Alum was at one time much used in *intermittent fever*, it having been recommended by Ettmüller, Lind, Müller, and others. Lange and De Mcza prescribed it with aromatics, and sulphuric acid or ether.³ Adair found the addition of alum and canella to bark very effectual in the cure of quartan agues.⁴ Boerhaave alludes to its use, and Van Swieten mentions that it is a custom with the common people to give alum and nutmeg to persons with the ague.⁵ Cullen found this combination a successful one. But before all of these, Geoffroy wrote, "Alum is by some reckoned a great specific in intermittent fevers,"⁶ after calcination, solution in vinegar, and recrystallization. A knowledge of these facts may not be without service to some who meet with cases in which the preparations of bark lose their effect.

Alum has also been resorted to as a means of moderating diarrhœa in *typhoid fever*. Fouquier,⁷ and also Barthez,⁸ employed it for this purpose. In an epidemic of the disease at Vienna in 1832, it was found useful when given in doses of from two to five grains every hour. Finally, it has been recommended as an internal remedy for the cure of aneurisms by Kreysig and Dzondi, and by Sundelin in palpitation of the heart;⁹ but of its efficacy in these affections there is neither proof nor probability.

Externally.—The styptic and constringent operation of alum is rendered practically useful in a great many cases of disease upon the

¹ Bull. de Thérap., i. 265.

² Ibid., xxxviii. 360.

³ COPLAND'S Dict. (Am. ed.), i. 1097.

⁴ DUNCAN'S Comment., x. 233.

⁵ Commentaries, vii. 284.

⁶ A Treatise of the Substances made use of in Physick, 1736, p. 120.

⁷ Bull. de Thérap., ix. 301.

⁸ Arch. Gén., 3ème sér., v. 105.

⁹ STRUMPF, Handbuch, i. 376.

surface of the body, or in parts readily accessible from without. The following are the principal disorders in which it may be prescribed.

Hæmorrhage. Before the present century alum was in general use as a styptic even in cases of traumatic hæmorrhage, but was also habitually employed in hæmorrhage from the nose, mouth, anus, vagina, &c. In uterine hæmorrhage solutions of alum were injected into the womb by Rivcrius and Leake, and a sponge saturated with a strong solution of the salt was introduced by the latter into the vagina. Fabricius Hildanus describes a tampon containing finely powdered alum as being used under similar circumstances.¹ Bleeding from leech-bites, from the jaw after the extraction of a tooth, and from similar situations, has been arrested by pressing upon the part a conical piece of alum, in the manner long ago recommended by Borelli and Diemerbroeck.² According to an ingenious suggestion of Dr. Wood, a dossil of lint or similar substance, saturated with a warm solution of alum, and allowed to cool in contact with the bleeding part, is the most efficient mode of making the particles of alum exert their astringent power.

Alum water, or brandy in which alum has been dissolved, may be used with great advantage to sponge the skin and moderate the colliquative sweats of tuberculous and other hectic diseases. This is an ancient practice, for it is mentioned by Aretæus,³ and Dioscorides prescribes lotions containing alum to prevent the fetid secretion from the armpits and other parts, which is peculiar to certain persons.

Ophthalmia. Cullen refers to alum curd as being in common use as an application in ophthalmia, but says that he found the watery solution more effectual. This solution (saturated) is preferred by Mr. Jacob to that of nitrate of silver, which, if long used, discolours the membrane.⁴ A weaker solution may be applied in cases of infantile ophthalmia. In 1832, M. Souty gave an account of the manner in which the natives of India treat purulent ophthalmia by means of alum mixed with the white of egg. The liquid, expressed from the mixture inclosed in a piece of muslin, is instilled into the eye every half hour if the inflammation is intense, and less frequently in milder cases, but is used in all stages of the attack.⁵ Another East Indian method of using this remedy is described by Mr. Waring, as follows: "I can speak from experience of the efficacy of the following native application: Place some finely-powdered alum on a heated plate of iron, and, while the salt is in a state of fusion, add a small portion of lemon or lime-juice, until it forms a black, soft mass. This, while hot,

¹ GMELIN, *Apparat. Medic., Regn. Min.*, i. 118.

² *Ibid.*, p. 117.

³ *Morb. Acut.*, lib. ii. cap. iii.

⁴ *Cycl. of Pract. Med.*, iii. 210.

⁵ *Arch. Gén.*, xxx. 116.

is placed entirely round the orbit, taking care that none of it gets beneath the eyelids, as it causes, under these circumstances, intense agony. One or two applications, each being allowed to remain on for twelve hours, are sufficient in ordinary cases to effect a cure."¹ Alum curd is one of the best applications that can be made in ecchymoses of the eyelids, and of similar parts. It should be inclosed in a bag of cambric, or some similar material, and renewed every three or four hours.

Diphtheritis and Tonsillitis. It has already been stated that Aretæus used insufflations of powdered alum in malignant inflammations of the throat. In modern times, its use is said to have been revived by Pommier, under the name of *anti-croupal powder*. It was also used with great reputed advantage by Löffler.² But the remedy first became generally known through Bretonneau, who, during an epidemic of diphtheritic angina in 1827, applied a paste of alum and water to the affected throat with more success than any other remedy.³ In 1828, Gendrin made use of powdered alum as an application to the throat in an epidemic of the disease, but judged it to be less efficacious than nitrate of silver.⁴ In the same year, Guersent and Velpeau, and, in the following year, Giraudet, adopted the method of Aretæus, and employed insufflations of alum with marked advantage.⁵ After some years' experience in its use, in 1835, Velpeau said that in all cases of *tonsillitis* it was wonderfully prompt in its effects, and, provided that an abscess had not formed, it cut short the inflammation "like magic." M. Trousseau, who had an opportunity of studying the epidemics described by Bretonneau, and also the disease as it appears in the hospitals of Paris, expresses a high estimate of the efficacy of alum in its treatment. When the diphtheritic affection is confined to the gums, a mouth wash, made by dissolving alum in vinegar and water, is usually sufficient, and will sometimes effect a cure when other remedies have been vainly tried for months together. "When the false membrane forms upon the tonsils, a simple gargle will suffice to remove it if the patient is an adult; but in children, and when the deposit extends beyond the pharynx, insufflations of powdered alum are necessary. For this purpose a tube of any material can be used, and about a drachm of finely-powdered alum having been introduced into one extremity, the other end of the tube is carried into the back part of the mouth, and by a sudden and strong puff the powder is blown into the pharynx. The cries of the child afford an opportunity

¹ Manual of Therapeutics, p. 23.

² RICHTER, Ausförl. Arzneim., iv. 232.

³ Archives Gén., xiii. 14.

⁴ Journ. Complément., xxx. 269.

⁵ Archives Gén., xvii. 503; and *ibid.*, xix. 586.

of accomplishing this purpose, which should be effected as much as possible during the act of inspiration. The operation, which should be repeated five or six times a day, always occasions vomiting and profuse salivation, but this disturbance subsides within a quarter of an hour, and it rarely happens that the gravest attack of diphtheritis does not yield to this treatment in the course of four or five days, if the interior of the larynx is not affected. When the plastic deposit occurs upon the skin, upon the nipple, or the mucous membrane of the genital organs, alum lotions, frequently repeated, readily cure this so often formidable inflammation."¹

Velpeau found powdered alum a very efficient remedy in an affection of frequent occurrence, and which, besides causing great pain, renders mastication impossible. It consists in an inflammation of the *gum* around the furthest molar tooth, particularly of the lower jaw. The swollen gum overlaps the tooth, the adjacent part of the cheek is hard and swollen, and the breath extremely fetid.² Burnt alum, in this case, is the most efficient form of the remedy. Mouth-washes and gargles of alum are serviceable in *mercurial ptyalism*. In that painful and often tedious affection known as *in-grown nail*, when the irritated parts have begun to ulcerate, and are covered with loose and flabby granulations, no better application can be made than burnt alum. It was used in 1823 by Sommé, of Antwerp, in the following manner. After applying a poultice for several days, and then removing with the scissors the portion of the nail imbedded in the flesh, he filled the cavity of the sore with the powdered alum, and renewed the application every day. It speedily dried up the discharge, and healed the sore if the patient refrained sufficiently from using the affected foot.³ Recently the value of this practice has been established by the author's experience of thirty years in its use.⁴ Indeed, wherever spongy or *exuberant granulations* are to be repressed, burnt alum may be depended upon as an efficient application. A solution of alum is among the most certain means of remedying the *relaxation of mucous membranes* resulting from inflammation or prolonged distension. Relaxation of the gums, uvula, and adjacent parts, of the vagina in consequence of childbirth or chronic leucorrhœa, of the sphincter ani permitting prolapse of the rectum, and similar conditions, are often remedied by this application. The ancients made use of it to strengthen joints that had been weakened by dislocation.

The alum lotion is said both to prevent and to cure *chilblains*. It

¹ Op. cit., 5ème éd., i. 156.

² Archives Gén., 2ème sér., vii. 564.

³ Ibid., i. 485.

⁴ Bull. de Thérap. (1852), xliii. 88.

is frequently a successful application in *pruritus vulvæ*, and is very efficacious in curing *leucorrhœa of the vulva*, a very common disease especially among children of the lower class, who neglect personal cleanliness. It sometimes occurs epidemically. As a remedy for *vaginal leucorrhœa*, alum is in very general use, and it is certainly one of the most successful of the remedies for this annoying and often recurring disease. A solution of one drachm of alum to four ounces of cold water may be used twice a day, and the proportion of alum gradually increased. Gautier, of Geneva, makes use, in the treatment of this disease, of the insufflation of finely pulverized alum, or of the introduction of a roll of cotton-wool containing in its centre a teaspoonful of powdered alum, and, finally, of tampons covered with a mixture of lard and alum in equal proportions. He states that the first and second of these methods often cause so forcible a constriction of the vagina as to render the introduction of the finger very difficult.¹

Toothache depending upon dental caries is said to be very often relieved by the method of M. Lefoulon, which consists in mixing together powdered alum, sulphuric ether, and a little mucilage, so as to form a paste, which is introduced into the cavity in the tooth. This application is renewed at first several times a day, and then less frequently, until the sensibility of the tooth is entirely destroyed.²

ADMINISTRATION.—Alum may be given *internally* in doses of from five to forty grains, and either in substance or solution. In the form of a fine powder, mixed with an equal proportion of pulverized sugar, or in molasses, it is taken without inconvenience. The addition of a few grains of cinnamon or nutmeg tends to correct its nauseating effects. If an emetic operation is desired, the dose of alum may be carried to one or two drachms, or even more, and while vomiting is promoted by copious draughts of warm water. In solution it may be given in sweetened aromatic water or in mucilage, with the addition of a small proportion of some preparation of opium.

The *alum whey*, which has been referred to above, is prepared by boiling two drachms of powdered alum with a pint of milk, and then straining. The average dose is a wineglassful.

Alum curd, procured in the manner just described, or by rubbing together powdered alum and the white of egg, may be applied to the affected part, covered with a piece of fine linen or gauze.

Solutions of alum are made of various strengths, according to the object in using them. In the ophthalmia of children, two or three grains to the ounce of water make a collyrium of sufficient astringency

¹ Abeille Méd., x. 303.

² TROUSSEAU AND PIDOUX, op. cit., i. 158.

for a first application; on the other hand, to arrest hemorrhages a saturated solution in hot water is the best.

Burnt alum and pulverized alum are used as local applications in the same cases. The greater lightness of the former renders it more appropriate for insufflations.

BISMUTHI SUBNITRAS.—SUBNITRATE OF BISMUTH.

DESCRIPTION.—The subnitrate of bismuth is prepared by dropping a solution of bismuth in nitric acid into distilled water. The subnitrate (trisnitrate) is precipitated, and a super-nitrate is left in solution. Guibourt states that in extracting bismuth from its ores, it ought to be melted a second time, and at a high temperature, to deprive it of arsenic, of which it always contains a portion, as well as of sulphur, zinc, lead, copper, and iron. For use in medicine, he adds, it should be still further purified by fusion with nitrate of potassa, which converts the arsenic into an arseniate of potassa. The latter, by its specific levity, separates itself from the metal.

Subnitrate of bismuth is a compound of one equivalent of nitric acid, one of teroxide of bismuth, and one of water. It is a dull-white, heavy, and inodorous and tasteless powder, composed of fine acicular crystals. It is very slightly soluble in water, but is readily dissolved in weak acids.

HISTORY.—Bismuth was confounded by the ancients with tin and lead, and was first distinguished from them by Stahl. The subnitrate, often called the *trisnitrate*, and, until 1802, the *white oxide* of bismuth, was originally prepared by Lemery, towards the close of the seventeenth century, as a secret medicine. The virtues for which it is now celebrated, are of comparatively recent discovery. Lemery himself speaks of its discutient and drying properties, and of its application in ointments and plasters.¹ Pomet mentions its use as a cosmetic and as a remedy for cutaneous eruptions.² Geoffroy says: "Some prepare flowers from it which they say are diaphoretic; but most physicians have been afraid to use it inwardly, because of the arsenical parts contained in it."³ Much later, Alston states that it is but little used except as a cosmetic,⁴ and Lewis, after remarking that it has been "recommended against gleetings sores, and internally as a diaphoretic," adds that it is now only employed as a cosmetic, and not always with-

¹ *Traité des Drogues Simples*, p. 127.

² *Hist. gén., &c.*, 3ème part., ch. xlv

³ *A Treatise of the Fossil, &c.*, 1736, p. 210. ⁴ *Mat. Med.*, ii. 332.

out injury to the complexion.¹ Of its internal use we have only the additional information that Pott had known it to occasion violent præcordial distress.

For the real introduction of subnitrate of bismuth into the *Materia Medica*, we are indebted to Odier, of Geneva, who published an account of its virtues as a remedy for gastralgia, in 1786.² Soon afterwards, Carminati and others confirmed his statements; but, in 1799, the medicine is stated to be "either neglected or forgotten," and how unjustly so, an example of its efficacy in "spasmodic pain of the stomach and bowels" is cited to prove.³ In England it was introduced by Dr. Marcet, who learned its virtues from Odier,⁴ and shortly afterwards Dr. Bardsley, of Manchester, added his testimony in its favor.⁵ In this country its virtues were first made known in the Inaugural Dissertation of Dr. S. W. Moore, of New York.⁶ In France, after having been used by Laennec, Guersent, and Bretonneau, and warmly advocated by Lombard, of Geneva, it was popularized by the encomiums of Trousseau, and especially of Monneret.

ACTION. On Animals.—The operation of this substance is far from being determined upon stable grounds. The results of experiments performed with it and of observations of its use in medicine, are often opposite and apparently irreconcilable. We shall endeavor to state these results fairly and succinctly. Orfila performed a number of experiments to test the action of the nitrate and of the subnitrate of bismuth. Among them were two in which the former of these substances was thrown into the veins, and the animals are said to have died in a state of exhaustion. In the other instances, the symptoms induced by the administration of either salt of bismuth, were vomiting, depression, debility, tremulousness, dyspnoea, and death. In every case the gastric mucous membrane was found inflamed, softened, and ulcerated. Orfila also states that nitrate of bismuth, administered by the stomach, could be detected in the liver and spleen, and in the urine.⁷ Symptoms and lesions like those above described, were observed by Meyer, of Bonn, in his experiments.⁸ Headland affirms, on the other hand, that subnitrate of bismuth is as perfectly insoluble in the fluids of the intestinal canal as charcoal, the simple metals, or woody fibre.⁹

On Man.—Monneret states that he has given from two to six drachms of this medicine, in the course of a day, to children of from

¹ *Mat. Med.*, 4th ed., i. 222.

³ *Lond. Med. and Phys. Journ.*, 1801, i. 511.

⁵ *Med. Reports*, 1807, p. 218.

⁷ *Toxicologie*, 5ème éd., ii. 10.

⁹ *Action of Medicines*, p. 75.

² *Gmelin, Apparat. Med.*, p. ii., i. 351.

⁴ *Mem. Med. Soc. Lond.*, 1801, vi. 155.

⁶ *Ecclect. Repert.*, i. 234.

⁸ *Wibmer, Wirkung, &c.*, i. 423.

two months to two years of age, and never saw the slightest evil effects produced by it; and he elsewhere remarks: "The imaginary description presented by Orfila, of the effects of subnitrate of bismuth upon animals, must be stricken from among the facts of medicine."¹ This author, whose experience in the use of the medicine is probably unequalled, affirms that it occasions neither thirst, nausea, vomiting, colic, nor other abdominal pain; that it does not impair, but rather stimulates, strengthens, and regulates the appetite, confining the bowels, rendering the stools black, and depriving them of their fetor, and further, that it produces no general symptoms whatever.² Finally, he affirms that on examining the bodies of persons who continued to take the subnitrate of bismuth up to the period of their death, this substance was found in the stomach unchanged in color or otherwise. In the duodenum it is apt to be retained by the valvulæ conniventes, and it gives a bluish color to this part and to the cæcum. In the large intestine it combines with the sulphur of the excretions, turns black, and tinges the mucous membrane with the same color. So far from occasioning ulcers, says M. Monneret, if they already exist in the bowel, the subnitrate protects them from the acrid contents of the intestine, and thus promotes their cicatrization.³

This evidence would seem conclusive of the innocuousness of the medicine, but we may append to it that of Trousseau. This eminent therapist declares that in all his extensive use of it, he has never known it to influence the circulatory, nervous, or secretory functions, or to occasion any symptoms which afforded the least ground for apprehension. What, then, are we to think of such statements as the following? Kerner mentions the case of a robust, but intemperate man, who, after taking two drachms of subnitrate of bismuth (*Magisterium bismuthi*) by mistake, to relieve heart-burn, died with all the symptoms of corrosive poisoning, including inflammation of the fauces and œsophagus, fever, diarrhœa, colic, suppression of the urine and muscular tremors, and paralysis. On examination of his body, excessive inflammation of the fauces and of the whole intestinal canal, with general gangrene of the former, and gangrenous spots in some portions of the latter, was discovered. The same writer describes among the effects produced by a dose of forty grains of the medicine, oppression or constriction of the epigastrium, faintness, headache, injected conjunctivæ, an anxious expression, a bitter taste in the mouth, thirst, anorexia, and a small, tense pulse. To these phenomena were

¹ Bull. de Thérap., xlvii. 213.

² Ibid., xxxviii. 436.

³ Ibid., xlvii. 118.

added violent eructation, colic, sometimes bilious vomiting, and thin evacuations from the bowels.¹ Sobernheim, after narrating Kerner's case, describes another which was fatal in nine days after a like dose, two drachms, of the medicine had been taken. The symptoms were those of intense gastro-enteritis, and, in addition, swelling of the face, hands, tongue, and abdomen, salivation, spasms of the limbs, dyspnœa, hiccup, and delirium. On examination of the body, the œsophagus, epiglottis, and larynx were found to be gangrenous, the stomach and intestine were highly inflamed, and the vicinity of the pylorus was also gangrenous.² Sobernheim attempts to explain the poisonous effects observed in these cases, by supposing that the stomachs of the individuals in question might have contained enough bi-tartrate of potassa to convert the insoluble subnitrate into a soluble and poisonous nitrate of bismuth. In the first case, as quoted by Orfila, it is expressly stated that Kerner's patient took the subnitrate of bismuth in mistake for magnesia, and having mixed it with cream of tartar, swallowed it. This mixture would generate the acid nitrate of bismuth, which has a styptic, caustic, and disagreeable taste, and bears a relation to the subnitrate like that of corrosive sublimate to calomel. To the above extraordinary narratives may be appended the not less extraordinary description given by Lussanna, of chronic poisoning by subnitrate of bismuth. "Its effects," he says, "are colliquative and scorbutic. The patient acquires a leaden aspect; the eyes become sunken, and present a livid subpalpebral circle; the breath is rendered offensive; the gums swell, grow livid, and discharge a sanious blood; hemorrhage is easily excited, and sometimes profuse passive hemorrhages arise."³ Effects such as these have not been reported by any other writer than Lussanna, and were never observed by Monneret or by Trousseau, whose use of the medicine has been more varied and extensive than that of any other physicians, and who have also administered it in larger doses. The cases of acute poisoning above quoted, may be explained, according to Trousseau, by supposing the medicine to have contained arsenic; but unless fraudulently or by mistake, no preparation of the subnitrate of bismuth could contain arsenic enough to account for the symptoms in question. One-sixth of one per cent. is the largest proportion of arsenic that has been found in any specimen of the subnitrate presumed to be pure. In a word, there is no reason whatever to apprehend poisonous effects from the subnitrate of bismuth prepared according to pharmaceutical rules.

¹ WILMER, *Op. cit.*, i. 416.² *Arzneimittellehre*, 6te Aufl., p. 268.³ *Dublin Quarterly Journal*, Feb. 1853; p. 253.

REMEDIAL EMPLOYMENT.—*Gastralgia*. The cases in which Odier originally administered bismuth are described by him as "*spasms of the stomach* brought on by any kind of aliment, and proceeding only from irritability of that organ. This complaint is extremely frequent at Geneva, particularly among servant-maids, who are in the habit of carrying water on their heads, and make great use of their arms."¹ Marcet describes it in the same terms, and so do Bateman, Clarke, Moore, and Bardsley, among those who were the first to publish illustrations of the virtues possessed by the new remedy. This affection, now regarded as a nervous disorder of the stomach, and known as *gastralgia*, is characterized by various painful sensations, and is variously described as a gnawing after food; a violent pain, sometimes so intense as to draw the patient double, and assuaged by firm and strong pressure upon the epigastrium; in other cases, as more steady and constant, and often attended with pulsation in the affected part, or a sense of sinking, followed by nausea and vomiting, and frequently by acid eructations. Oftentimes the desire for food is not impaired, and is only transiently suspended by vomiting. When of long standing, *gastralgia* induces debility, loss of flesh, constipation, sometimes with alternations of diarrhœa, and a depression of spirits which is apt to induce a suicidal propensity.

This distressing affection Odier treated successfully with six grains of bismuth four times a day, though he also tried the medicine in much larger doses. The greater number of practitioners have found the quantity named sufficient, but Monneret recommends that not less than two drachms and a half should be given during the first day, and twice as much on the second, after which, he says, the quantity should be increased until the daily dose reaches one, two, or even three ounces. In this manner, he insists, cures may be effected which would otherwise be impossible;² but we are persuaded that a necessity for such enormous doses can seldom exist.

Subnitrate of bismuth displays powers which may be almost called specific in cases of pure *gastralgia*; but the more this affection is complicated with other disorders, and especially with such as depend upon an impoverished condition of the blood, the less efficient does the remedy become. Even in cases of simple *gastralgia* of a severe type and long continuance, its benefits are very transitory; so much so, indeed, as to confirm a belief in its mechanical operation. It becomes necessary, therefore, to administer the remedy frequently, and to asso-

¹ Mem. Med. Soc. Lond., vi. 157.

² Bull. de Thérap., xlvii. 116.

ciate with it, in the treatment of individual cases, vegetable tonics when the digestion continues feeble after the removal of the pain, alkalies or magnesia when the vomited matters are intensely acid, and iron when evidences of anæmia exist. Constipation, if present, is also to be overcome by means of laxatives, and the best are usually magnesia or small doses of salines largely diluted. In some cases the action of bismuth is promoted by the administration of a few drops of laudanum or of hydrocyanic acid at the beginning of a meal.

Other forms of gastric derangement, characterized less by acute than by dull pain, or by an excessive secretion of acids in the stomach, an unnatural craving appetite for food, induced by a sense of perpetual sinking at the epigastrium, or accompanied by a profuse secretion of gas, are usually benefited by the medicine under consideration. The vomiting which attends cancer of the stomach is often palliated by it, and even nervous vomiting, such as that of pregnancy, is sometimes temporarily suspended by its use.

Diarrhœa.—Subnitrate of bismuth was employed, in 1831, by Dr. Leo, of Warsaw, for the diarrhœa and vomiting of *cholera*; and in the following year, for the same affections, by M. Trousseau, of Paris. The latter writer informs us that during the epidemics of 1849 and 1854, and especially the latter, the medicine came into general use, not only among physicians, but as a popular remedy, to counteract the premonitory diarrhœa peculiar to the disease. It is equally efficient in other forms of diarrhœa, for which antacids and astringents are usually given. It was also prescribed, at an early period, by Guersent, Lombard, and Trousseau, in cases of diarrhœa affecting infants fed artificially, and during dentition, or when they are too suddenly weaned. Two or three grains, mixed with a small quantity of powdered loaf sugar or simple syrup, and administered three or four times a day, are said to be usually sufficient for correcting the disorder. But Monneret, who is even more emphatic regarding the efficacy of this remedy in these affections, and also in gastro-intestinal softening of new-born infants, affirms that doses like those just mentioned are nugatory, and that from two to five drachms a day should be given to children between the ages of two months and one year—that, in fact, the medicine is as harmless as so much starch.¹

In various forms of chronic diarrhœa bismuth has also been used with marked advantage; in all, indeed, which do not contraindicate the use of astringent medicines. Such, in particular, is the form which depends upon relaxation of the bowels, associated with general

¹ Op. cit., xlvii. 265.

want of tone in the system. Trousseau has even found it a valuable remedy for the diarrhœa which persists in some cases of typhoid fever after the decline of the febrile movement. He prescribes from half a drachm to two drachms in the course of the day, either alone or in conjunction with lime-water, and sometimes with the addition of a few drops of laudanum. This writer states that he has frequently employed the medicine in the diarrhœa of phthisis, but unsuccessfully;¹ and Lussanna found it equally unavailing.² Other physicians have been more fortunate. Dr. Theophilus Thompson, after repeated trials, declares the result of his experiments to be a conviction "that this is the form to which bismuth is especially applicable, and that, both in efficacy and safety, it surpasses our most approved remedies for the complaint."³ Dr. T. administered the medicine in doses of five grains, usually combined with three of gum Arabic and two of magnesia, at intervals of four or six hours. Monneret, who, however, prescribed the subnitrate of bismuth in doses of nearly an ounce every day, is still more emphatic respecting its virtues in the present case, whether the diarrhœa attend the forming or the declining stage of phthisis. His testimony is so positive that we quote it literally. "In the last seven years," he remarks, "during which I have administered this medicine in tuberculous diarrhœa, I have seen many persons, who appeared to have but a few days to live, cured of their diarrhœa so far as to be able to take food, gain flesh and strength, and quit the hospital under an impression that they were cured."⁴ Testimony so positive, and proceeding from such credible witnesses, we may neither contradict nor disregard.

The author last quoted, and also Laségue, found this remedy a very efficient one in the treatment of sporadic *dysentery*. It was administered by the mouth and also by injection, and, although it was the only medicine prescribed in many cases, it accomplished a speedy cure.

Externally.—The absorbent, astringent, and protective powers exerted by subnitrate of bismuth have been fully tested by its application in various external or local diseases. Caby treated *gonorrhœa* successfully by means of injections of this substance suspended in water, in the proportion of one part to seven. He used, with equal advantage, in the treatment of *leucorrhœa*, a dressing of dry charpie sprinkled with bismuth powder, and renewed from day to day. The rapidity of the cure is represented as extraordinary in all cases which have assumed a decidedly chronic type.⁵ The efficiency of the application is

¹ Bull. de Thérap., iv. 267.

² Dub. Quart. Journ., Feb. 1853, p. 254.

³ Med.-Chir. Trans., xxxi. 305.

⁴ Bull. de Thérap., xlvii. 217.

⁵ Bull. de Thérap., xlvii. 200; lv. 193, 259.

also said to be equally decided in that form of infantile leucorrhœa which has sometimes been mistaken for gonorrhœa, and which is most apt to occur in feeble and scrofulous children living in poverty and filth.

No remedy is more efficient than the one under notice in the treatment of *intertrigo*, an affection which often resists, or is aggravated by, all ointments and solutions, and by most of the dry powders. According to Gillette,¹ of all the dry applications employed to hasten the cicatrization of *ulcers*, this is the best (provided that the granulations are on a level with the skin), when the secretion of the sore has not sufficient consistence to form a scab, or when its situation exposes it to friction. Such a condition is often presented by scrofulous sores, by the ulcers which follow pemphigus, and those which are of a scrofulous nature. Powdered bismuth has also been found a very serviceable dressing for the excoriations of chronic eczema, for fissures of the anus, for bed-sores, and, in general, for all cases in which there is a fetid secretion. Monneret relates the history of two aggravated cases of scrofulous *ozæna*, the one occurring in a woman, and dating almost from her birth, the other in a man, and of five years' duration, both of which were speedily cured by repeated inhalations through the nostrils of finely powdered bismuth. Nothing else was done than to cleanse the nasal passages by a daily injection of tepid water. Soubrier has also reported favorably of this method.²

ADMINISTRATION.—The dose of subnitrate of bismuth is not restricted within narrow limits. To infants at the breast it may be given in doses of three grains, or more, at intervals of three or four hours, and to adults in doses of five or ten grains, or more, three or four times a day. It is most advantageously administered immediately before eating, mixed with a little milk, soup, mucilage, or other similar liquid. It may also be given in sweet preparations, such as jellies, honey, or molasses; but these are less eligible when the digestive organs are the seat of disease, and as the subnitrate has no taste the simpler the vehicle of its administration the better.

SUBCARBONATE OF BISMUTH.—Dr. Hannon, of Brussels, has proposed the subcarbonate as a substitute for the subnitrate of bismuth. It is prepared by dropping a concentrated solution of nitrate of bismuth into a solution of carbonate of soda. An amorphous precipitate of the subcarbonate of bismuth is formed, which is afterwards purified by repeated washing with distilled water.

¹ Bull. de Thérap., xlvii. 418.

² Abeille Méd., xv. 166.

This preparation, in doses of from seven to ten grains, is said to act primarily as a sedative upon the circulation, to excite a free discharge of limpid urine, and to diminish the appetite. If, however, the medicine is continued for a few days, these phenomena cease, and opposite effects are manifested. The pulse becomes fuller and firmer, the appetite stronger, the digestion easier, and ultimately the nutrition is improved. The subcarbonate possesses the advantage over the subnitrate of neutralizing the free acids in the stomach.¹

CALCIS LIQUOR, vid. *Irritants*.

CUPRI SULPHAS, " "

FERRI SULPHAS, " *Tonics*.

PLUMBUM.—LEAD.

DESCRIPTION.—Lead is usually found combined with *sulphur* in the mineral called *galena*, but it also occurs as an *oxide* (*minium*), and as a *salt*. Its haloid salts are numerous, more so than the sulpho-salts, but less so than the oxysalts. It is, however, from *galena* that the lead of commerce is chiefly extracted. This mineral is found in England, Spain, Germany, and other European countries, and also very abundantly west of the Mississippi, from Wisconsin on the north to Arkansas upon the south.

Galena, when roasted, yields the greater part of its sulphur in vapor, forming sulphuric acid, but still retains a portion of it together with oxygen, which forms an oxide of lead. By the further action of heat, after the addition of coal and lime, the remaining oxygen and sulphur are removed. Metallic lead is of bluish-gray color, presents a bright shining surface when freshly cut, has a peculiar taste, and also smell when handled, and a sp. gr. of 11.4. In dry air it undergoes but little change, but, exposed to moist air, it is first oxidized, and then attracts carbonic acid. Pure distilled water exerts no action upon lead, unless atmospheric air be present, in which case a carbonate is formed. Drinking water, which is usually distributed through leaden pipes, contains alkaline and earthy sulphates, which undergo decomposition and are precipitated until the internal surface of the pipe is coated with a sulphate or other insoluble salt of lead. If this surface is alternately exposed to the atmosphere and used as a channel for water,

¹ Bull. de Thérap., lii. 110.

the latter becomes impregnated with lead, and acquires poisonous qualities.

The compounds of lead used in medicine are the protoxide, the iodide, the acetates, the carbonate, and the nitrate. We shall succinctly describe the modes of preparing them, and their physical properties.

Plumbi Oxidum Semivitreum.—SEMIVITRIFIED OXIDE OF LEAD ; LITHARGE.

This substance is obtained by the action of a current of air upon the surface of lead in a state of fusion. It is in the form of red or yellow, shining scales, without taste or smell, and has the property of forming soaps when heated with fat or oils, in connection with water. It may be used for the preparation of the acetate, subacetate, and nitrate of lead, and enters into the following pharmaceutical preparation:—

Emplastrum Plumbi.—LEAD PLASTER ; LITHARGE PLASTER ; DIACHYLON.

This compound is formed by boiling together semivitrified oxide of lead, olive oil, and water. On heating these substances together the oil and water are supposed to react upon one another, producing oleic and margaric acids, which combine with the oxide of lead, forming the plaster in question, with which also the glycerin unites mechanically.

Lead plaster is usually sold in cylindrical rolls, of a clay color, but becoming darker by exposure. It is hard and brittle when cold, but, on being warmed, becomes softer and adhesive. With resin it forms *Adhesive Plaster* (EMPLASTRUM RESINÆ), which is usually spread by means of a machine upon linen or cotton cloth. With soap it constitutes *Soap Plaster* (EMPLASTRUM SAPONIS).

Plumbi Iodidi.—IODIDE OF LEAD.

This compound is formed by the double decomposition of nitrate or acetate of lead and iodide of potassium dissolved in water, and consists of one equivalent of each of its constituents. It is a heavy gold or orange yellow powder, without smell or taste, soluble in about 200 parts of hot and 1200 of cold water, soluble also in alcohol, and decomposed by heat, with extrication of iodine. It should be kept from the access of light. An *ointment of iodide of lead* is prepared by mixing one part of the iodide with seven of lard (*Dub.*), or with eight of lard (*Lond.*).

Plumbi Acetas.—ACETATE OF LEAD ; SUGAR OF LEAD.

There are five acetates of lead, but only two of them are employed in medicine, the present one and the diacetate (subacetate). Acetate of lead is produced by the direct action of dilute acetic acid upon thin

plates of lead exposed to the air. It consists of one equivalent of oxide of lead and one of acetic acid with three equivalents of water.

Acetate of lead occurs in acicular prismatic crystals, of a white color, efflorescing slightly in a dry, warm atmosphere, and undergoing decomposition by the carbonic acid of the air. It is soluble in alcohol, and in cold, but much more readily in hot, water. In pure distilled water its solution remains clear, but in ordinary water the acetic is replaced by carbonic acid, forming a carbonate which renders the liquid turbid, and liberating the acetic acid, which gives to the solution a sour taste and smell. The addition of an excess of acetic acid will redissolve the carbonate. Acetate of lead has a sweetish, astringent taste, and a somewhat sour smell.

Acetate of lead is decomposed by a great variety of substances, including most of the acids and their salts, vegetable astringents, the alkalies and alkaline earths (as in hard water), several mucilages, and albumen; but of the compounds thus formed the only ones which are probably inert are those with sulphuric acid, and other soluble compounds of sulphur.

Liquor Plumbi Subacetatis.—SOLUTION OF SUBACETATE OF LEAD.

This preparation is made by boiling together a solution of acetate of lead with oxide of lead. The acid seizes upon a fresh proportion of the oxide, and two portions of the subacetate result. This salt consists of one equivalent of acetic acid and two of protoxide of lead. It has an alkaline reaction, and a sweetish, astringent taste. It is precipitated from solution by the substances which are incompatible with the neutral acetate, and even more copiously by some of the mucilages, particularly by gum Arabic, which has but little effect on a solution of acetate of lead.

For the convenience of application, a diluted form of this solution is officinal (LIQUOR PLUMBI SUBACETATIS DILUTUS), and is made with two fluidrachms of the stronger solution to a pint of distilled water. The Dublin Pharmacopœia directs a small proportion of alcohol to be added, in imitation of the *eau végéto-minérale* of Goulard, in which alcohol forms about one-sixteenth of the solution. The diluted officinal solution is generally known as Lead Water.

Ceratum Plumbi Subacetatis.—CERATE OF SUBACETATE OF LEAD; GOULARD'S CERATE.

This cerate is prepared by mixing the solution of subacetate of lead with white wax and olive oil, previously melted together, and adding to the mixture a small quantity of camphor. It should, as far as possible, be prepared fresh for use, as it speedily becomes rancid.

Ceratum Saponis—SOAP CERATE.

In this preparation soap is boiled in a solution of subacetate of lead, by which means the latter is decomposed; its acetic acid unites with the soda of the soap, and the oleic and margaric acids of the latter combine with the oxide of lead. After having been reduced by evaporation to dryness, wax and oil, previously melted together, are mixed with the compound.

Soap cerate is white, and is readily spread upon linen or cotton cloth.

Plumbi Carbonas.—CARBONATE OF LEAD; WHITE LEAD; CERUSE.

White lead is prepared by several methods. A neutral carbonate of lead may be obtained by the double decomposition of acetate or nitrate of lead and of an alkaline carbonate in solution. By this process a carbonate of loose texture is produced, too loose for the purposes in the arts for which the compound is designed. The most usual methods are the following. A solution of the diacetate of lead (subacetate) is decomposed by means of a stream of carbonic acid passed through it. Carbonate of lead is precipitated, and a neutral acetate remains in solution. Or thin sheets of lead are exposed during several weeks to the vapor of vinegar raised by the heat generated during the fermentation of tan or of stable litter. This fermentation also develops carbonic acid, and reactions like those in the first process ensue; the subacetate parts with one equivalent of its lead, which combines with the carbonic acid to form a carbonate, leaving a neutral acetate, which, in its turn, takes up another equivalent of lead, and returns again to the state of a subacetate.

Carbonate of lead is white, pulverulent, heavy, tasteless, and inodorous; it is decomposed with effervescence by nitric acid, is blackened by sulphuretted hydrogen, and is very slightly soluble in water containing carbonic acid.

Unguentum Plumbi Carbonatis.—OINTMENT OF CARBONATE OF LEAD.

This ointment is made by incorporating finely-powdered carbonate of lead with simple ointment, in the proportion of two ounces to a pound.

Plumbi Nitras.—NITRATE OF LEAD.

This compound is made by the action of nitric acid on protoxide of lead (litharge), and consists of one equivalent of each ingredient.

It is a white, opaque crystalline substance, undergoing no change in the air, soluble in water and alcohol, and having an astringent and sweetish taste.

HISTORY.—Lead was known as a metal and employed in the arts long before the Christian era, for it is mentioned in the books of Moses,

and Theophrastus describes one of its preparations as a pigment. Hippocrates refers to minium¹ as one of the ingredients of a pessary to arrest hemorrhage during pregnancy, and Nicander, who lived in the second century before Christ, and who wrote a valuable treatise on *alexipharmics*, describes distinctly the phenomena of poisoning by the preparations of lead. Celsus mentions calcined lead among the remedies for hemorrhage, dross of lead among the emollients, and washed lead as an ingredient of a certain malagma for the bones.² Pliny describes the manufacture of pipes and plates of lead, and various uses to which the metal is applied. He also states that in medicine it is used to render scars smooth; that plates of it worn upon the loins blunt venereal desires and prevent nocturnal pollutions; that calcined lead (oxide of lead) is astringent, repressive, and healing, and is used in inflammations of the eyes, to promote the healing of wounds, and to cure excrescences, fissures of the anus, piles, and condylomata. Pliny also describes a mode of preparing ceruse essentially like that used at the present day, and states that women use this substance to whiten the complexion. He adds, further, that, taken internally, it is poisonous.³ The account given by Dioscorides corresponds closely with that of Pliny, and Galen adds nothing but his own confirmation of these statements, and a vain attempt to explain the hidden qualities of the metal,⁴ except that water conveyed in leaden pipes sometimes proves deleterious by occasioning dysentery. Aretæus, Aetius, Palladius, Vitruvius, and Paul of Ægina also describe lead colic and paralysis from lead with more or less minuteness. The symptoms of lead-poisoning are still more fully detailed by the Arabian writers, who enumerate among them colic, suppression of urine, constipation, pains, and paralysis affecting the limbs.⁵

The internal use of the salts of lead appears to be of modern origin, and to have been first resorted to by the chemical physicians of the sixteenth century, and especially by Paracelsus and Otto Tachenius.⁶ But even in the last century, Boerhaave, after stating that sugar of lead had been recommended as a safe internal remedy for hæmoptysis and other hemorrhages, gonorrhœa, leucorrhœa, &c., adds emphatically that he had never dared to use it, because he had witnessed no striking successes obtained by those who employed it, and believed it to be a treacherous and dangerous poison.⁷ Geoffroy, also, while

¹ *Μίλτος*, Ed. Fœs., i. 267. He also describes (*Morb. Mulier.*, ii. v.) a concave leaden pessary for supporting the womb.

² GRIEVE'S CELSUS, pp. 207, 214, 223.

³ *Hist. Nat.*, xxxiv. xlviii. to lv.

⁴ *Mat. Med.*, and *Comment. of Matthiolus*, v. lv., and vi. xxii.

⁵ Quoted by TANQUEREL DES PLANCHES, *Maladies de Plomb*, i. 32.

⁶ GMELIN, *Apparat. Med.*, Pt. II., i. 414.

⁷ *Chem. Lect.*, ii. 456.

admitting that it calms effervescences in the blood and checks the progress of inflammations, and that the sugar of lead is by some recommended inwardly in spitting of blood, dysenteries, &c., still concludes by saying that it is much safer to confine it to outward applications.¹ De Haen observes: "Sacchari saturni usus internus laudatur, quia refrigerat et exsiccat, semen extinguit et vencrem flacciscentem inducit." Cullen, in 1789, remarks that "hardly any practitioner will now think of employing any preparations of lead as internal medicines."² In 1791, Lewis, while admitting the powers of lead to control profuse evacuations, says that "it ought never to be ventured on but in desperate cases, as a last resource."³ In 1813, Murray, of Edinburgh, expressed a similar opinion.⁴ About the same time, on this side of the Atlantic, Barton, in imitation of the practice of Dr. Reynolds, of London, published many years before, employed acetate of lead in hemorrhages, extending the range of cases to which he applied it, and using it also for the cure of dysentery and various profluvia.⁵ In Germany it was adopted by Amelung, Kopp, Osann, Jahn, and others,⁶ in the treatment of similar affections, as will appear more particularly in the sequel. But in France we find MM. Fournier and Vaidy using the following singular language as late as 1814. Alluding to the employment of acetate of lead in dysentery by Dr. Ewell, of Washington, they say: "The suggestion, which betrays an utter ignorance of the deleterious qualities of this poison, is so absurd a fancy that we do not think that it even merits discussion."⁷

ACTION. *On Animals.*—The immediate or irritant properties of lead are illustrated by the effects of the soluble compounds of this metal, the acetates, the nitrate, and the iodide; but the insoluble preparations, the oxides and the carbonate, manifest a poisonous power in so far only as they are converted into soluble salts by the liquids of the economy. The acetate of lead is the preparation which it is of most importance to examine in this connection. When this salt is given to dogs, in the dose of from two to four drachms, it occasions signs of pain, vomiting, loss of flesh, if death is long delayed, or death within a day or two if vomiting is prevented by a ligature upon the œsophagus. When death takes place speedily, the stomach is found highly injected, and the bloodvessels are gorged with black blood. If the

¹ A Treatise on the Substances made Use of in Physick (1736), p. 239, &c.

² Mat. Med., ii. 28.

³ Mat. Med., ii. 236.

⁴ A System of Mat. Med., i. 285; ii. 347.

⁵ DUNCAN'S Med. Com., xii. 190; BARTON'S CULLEN (1812), ii. 20.

⁶ BURDACH, System der Arzneim. (1818), ii. 232.

⁷ Dict. en 60 vol., x. 384.

dose has not been large enough to cause death within a few days, paralysis, first of the hinder and then also of the fore limbs, ensues, difficulty of breathing, signs of extreme distress, convulsive respiration, and death by exhaustion. The mucous membrane of the stomach and upper portion of the small intestine is then sometimes found injected, or eroded, and covered with a thick, tenacious mucus; but it seldom or never presents evidences of a true ulceration. The *iodide* of lead produces essentially the same effects as those above described; and the *nitrate* is, according to Dr. Christison, a powerful irritant and corrosive in the dose of 400 grains.

When the salts of lead are injected into the blood in considerable quantities, death may follow rapidly, with signs of pulmonary congestion, feebleness of the heart, and oftentimes convulsions. The organs mentioned are found overloaded with blood, particularly the lungs and the right side of the heart. It appears probable that these effects and their corresponding symptoms depend upon the coagulation of the blood in the pulmonary vessels, but in some degree also upon a direct sedative influence exerted upon the nervous system. Although, at the present day, it will hardly be supposed that lead can produce the effects with which all are familiar, without having been absorbed into the blood, and with it distributed to all parts of the organism, it may not be uninteresting to have the direct evidence of this fact prescribed. Tiedemann and Gmelin detected lead in the blood of the portal vein of horses and dogs poisoned by acetate of lead, and Orfila found it in the liver, the spleen, and the urine of animals destroyed in the same manner. Tanquerel, Dévèrgie, Guibourt, Miller, and others, found the metal in the paralyzed muscles of persons who had died of chronic lead-poisoning.¹ Dr. G. Wilson detected it more abundantly in the spleen than in the other organs of animals that perished from the effects of drinking water impregnated with carbonate of lead from a neighboring manufactory, and of eating grass, in the blades and roots of which, and also in beans growing in the adjacent soil, lead was ascertained to be present.²

M. Grisolle states that domestic animals are affected as injuriously as man by the emanations of lead. Cats and dogs frequenting lead manufactories nearly all die in convulsions, being sometimes stricken down suddenly, but sometimes they become blind and run wildly about, striking against everything in their way. In the midst of their course they are often seized with convulsions, and generally they die in such an attack. These phenomena sometimes manifest themselves

¹ Med.-Chir. Trans., vii. 114.

² Ed. Month. Journ., May, 1852, p. 386.

after the animal has been for several days dull and dejected; and in certain cases they have been observed after it has drunk water impregnated with carbonate of lead.

On Man. Locally.—In their local operation, the compounds of lead are astringent, and are usually said to be sedative, but they are somewhat different in the energy of their action. The nitrate, without being an active irritant, appears to operate as a healthy stimulant when applied to ulcers, which it tends to heal while it lessens the secretion from their surface. By means of its affinity for sulphur, it decomposes sulphuretted hydrogen, and thus becomes one of the most efficient of deodorizing agents. This quality has also caused nitrate of lead to be regarded as a disinfectant, but there is no reason to suppose that it affects the specific poisons upon which infectious and contagious diseases depend, further than by depriving them to some extent of the soil most favorable to their development.

Internally, the acetate of lead, in small doses, is sedative, for if continued it lessens the frequency of the pulse; it is also astringent, as its control over excessive secretion from the gastro-intestinal mucous membrane abundantly proves. When an overdose of this salt is taken, as one or two ounces, for example, the following symptoms are usually exhibited. A sweet, styptic, and astringent taste is perceived in the mouth, and a sense of constriction in the fauces; severe gastric and abdominal pains are soon afterwards experienced, and are increased by pressure; there is nausea, very frequent vomiting of a yellowish, greenish, or blackish liquid; stools are frequent and sometimes bloody; the limbs tremble and are affected with slight spasms, and a sense of constriction; convulsions even may take place. Sometimes there is a giddiness resembling that of intoxication, or the mind may be quite unaffected. The thirst is urgent, the skin hot, the pulse frequent and sometimes strong, but more generally small and tense; the respiration is interrupted and hurried, especially in the later stages of the attack, and the urine is scanty. Unless aid is given, death may take place in the course of a few hours or days.¹ MM. Rognetta and Flandin deny the probability of this termination, for they assert that the soluble salts of lead may be given to man in considerable doses without occasioning very serious symptoms, but Orfila states that several cases of fatal poisoning by them have occurred, and he treats the assertion just quoted with contempt. Yet it coincides pretty nearly with Dr. Christison's statement, and also with that of Dr. Taylor, who says that "acetate of lead is by no means a very active

¹ ORFILA, Toxicologie, 5ème éd., i. 849.

poison, although it is popularly considered to possess a very virulent action."¹ Several cases might be cited in which doses varying from two to eight drachms have been taken without injury. It sometimes, however, without destroying life, induces a protracted derangement of the digestive function.

Several cases of fatal poisoning by the *subacetate* of lead, in large doses, are recorded in the works on Toxicology. Mr. Taylor refers to four examples of this accident. The *carbonate* of lead, on the other hand, does not appear capable of inducing serious symptoms by any direct influence upon the system. Doses of an ounce, or an ounce and a half, have several times been taken by mistake, or with criminal intentions, without doing any harm.

Far more frequently serious results arise from the slow and gradual introduction of lead into the system. In order to determine the limits beyond which it may not be prudent to go in the administration of the salts of lead, Mr. Laidlaw performed the following experiments upon himself.² While in good health, he took sixty grains of acetate of lead in the course of four days. The symptoms developed were these: a metallic taste in the mouth, some tenderness and swelling of the gums, diminished frequency with feebleness of the pulse, and soreness and pain at the epigastrium on taking the last ten grains of the medicine at a single dose. A dose of salts put an end to these symptoms, and no subsequent disturbance occurred. A month afterwards the experiment was repeated. Seventy grains of the acetate were taken in the course of eight days. The metallic savor began to be perceived on the second, and the swelling of the gums on the third day, and the bowels were constipated. On the fourth day, a purge of jalap and rhubarb caused an abatement of the symptoms; but on the sixth day, the medicine having been continued, they returned, accompanied by constriction of the thoracic and abdominal pains. By the ninth day, they had increased, and in addition to them there was ptialism, and a sensation of tightness or numbness of the hands and feet. A dose of salts again removed all of the symptoms except the salivation and swelling of the gums, which were very unusual, and, indeed, quite exceptional symptoms.

A similar illustration is afforded by the case of Dr. Spence, of Virginia, who began by taking a quarter of a grain three times a day, gradually increasing the dose until at the end of three weeks he was taking eight grains twice a day. The symptoms noticed by Dr. S.

¹ On Poisons (Am. ed.), p. 347.

² Lond. Med. Repos., and Journ. of Foreign Med. (Philad., 1828), p. 395 and 527.

were costiveness, spongy gums, a *livid appearance around the dentes incisores* (this is the earliest record of that important symptom), diminished flow of saliva, fetid breath, looseness of the teeth, without soreness of the mouth, costiveness, and blackened fæces. Neuralgic pains now affected the upper, and afterwards the lower extremities, the appetite failed, and a slight attack of lead colic supervened, with loss of muscular power in the limbs. The pulse also fell from 80 to 60.¹

That which happened in these experiments, and even more, is said to have taken place in not a few cases in which acetate of lead has been administered medicinally. Tanquerel presents evidence of the truth of this statement in examples drawn from Fernel, Ettmüller, Tulpius, Tralles, Van Swieten, Hoffmann, James, Tronchin, Tissot, Chomel, Fizeau, and Fouquier, to whom might have been added Carrière, Bieking, and others. But lest too much weight should be attached to these names, dating through two centuries of time, it must be added that they who are most familiar with the use of this salt as a medicine, the practitioners of England and America, have scarcely reported a single case in which serious effects have been produced by it. Some colic, and occasionally a troublesome degree of constipation, constitute nearly the total of its untoward results.

Lead poisoning is manifested chiefly by a derangement of the nervous system, for even in lead colic the symptoms are evidently due to this more than to any lesion of tissue, and it always results from the gradual introduction of lead into the economy by those who inhale or otherwise imbibe its particles during the manufacture or use of the metal, or who drink water or other liquids impregnated with it. Undoubtedly the stomach and the lungs constitute the ordinary channels of its entrance into the system, but it is probable that all of the mucous membranes, and the denuded cutis, are capable of absorbing it, and that it may, if repeatedly and constantly applied even to the sound skin, be absorbed, and produce its characteristic effects. This is made evident by the liability of type-setters to that peculiar form of paralysis called dropped hands, and also by the not infrequent cases of lead poisoning which have occurred in consequence of employing cosmetics made with lead. It should be known that preparations of this metal in contact with the denuded cutis have very frequently occasioned the symptoms of poisoning peculiar to it. Thus, lotions of the acetate or subacetate of lead applied to excoriated or otherwise denuded portions of the skin have produced this effect, and so have adhesive plaster used to draw the opposite edges of large ulcers together, and lead ointments

¹ Philad. Med. Museum, ii. 250 (1805).

employed as dressings for open sores. Very small quantities of lead have sometimes developed symptoms of poisoning. Thus, several cases of complete lead poisoning have been traced to the use of snuff containing the red oxide of lead, or supposed to have become impregnated by being packed in leaden cases,¹ and to very temporary exposure to the emanations of white lead paint.² Among the effects of lead colic is that which is most readily produced by drinking sophisticated wines, or water impregnated with lead, by sleeping in a freshly-painted room, especially if artificial heat is employed to hasten its drying, by using or preparing lead paints with spirit of turpentine, by the manufacture of white lead, and by the fumes of the melted metal.

Among those who work in lead the emanations of this metal are apt to produce a peculiar cachexia before the more definite diseases which it gives rise to are developed. Its signs are loss of flesh, or a flabby state of the muscles, a sickly pallor of the countenance, and, judging from the shrunken state of the veins and discoloration of the skin, anæmia in its most marked degree. The sweetish taste in the mouth, mentioned by Mr. Laidlaw, is perceived, and is accompanied with a sickly fetor of the breath. The gums are sometimes swollen, and salivation occurs, as in his case, and along the attachment between the teeth and the gums the latter are often eroded and present a bluish line. This peculiar symptom appears to have escaped the notice of European physicians until 1834, when it was noticed by Dr. Henry Burton, and subsequently described by him as "a narrow leaden-blue line, about one-twentieth part of an inch in width, while the substance of the gum apparently retained its ordinary color and condition."³ It does not, however, like the red line which precedes mercurial salivation, prove the saturation of the system with the mineral. It is a local effect produced by the action of the sulphur contained in the food, or in the eructations from the stomach, upon the lead mixed with the saliva, and which tends to lodge along the line which has been mentioned. Not unfrequently the discoloration is not limited to the parts indicated by Mr. Burton, but occupies a considerable portion of the gums, and even forms spots upon the lining membrane of the cheeks.

The *colic* produced by lead was, as we have elsewhere shown, well known to the ancients, but one of the first complete descriptions of it, and to this day one of the best, was published by Dr. Warren, of London, in 1768.⁴ The name of the disease is derived from one of its conspicuous symptoms, severe pain in the abdomen, having something of the same

¹ Am. Journ. of Med. Sci., Oct. 1857, pp. 406 and 542.

² Liverpool Med.-Chir. Journ., i. 26.

³ Med.-Chir. Trans., xxiii. 66.

⁴ Trans. Lond. Coll. Phys., ii. 68.

character as those of colic from cold or from indigestible food ; but the pain differs in these respects, that it is vastly more severe, that it is not subject to such complete remissions, and above all that it darts in every direction, to the back, loins, ureters, scrotum, and groins, or occupies the thighs and legs, or the muscles of the chest and of the upper limbs. In a word, it has all the characters of a severe neuralgia whose greatest severity is expended upon the digestive organs. Besides the prostration of strength and haggard sunken features which testify to the patient's sufferings, a capital symptom is constipation, which is extremely obstinate, and is accompanied with great retraction of the abdomen, sometimes firm contraction of the sphincters of the bladder and rectum, and retching with frequent vomitings of very acrid, bitter, and somewhat greenish mucus. This symptom is probably due to spasmodic obstruction of the intestine. Meanwhile there is no fever; the pulse, on the contrary, is infrequent, and the skin cool; but there is sometimes extreme nervous irritability, and even hyperæsthesia of the skin. Many observers have noticed the diminished frequency of the pulse under the influence of the preparations of lead. Tanquerel did not fail to note it; it was a striking symptom in the experiments performed by Mr. Laidlaw; more recently (1852), Barthez observed it when affections of the bowels were treated by saturnine injections; and still more recently (1856), Dr. Corson, of Brooklyn, studied very particularly the feeble action of the heart in persons debilitated by lead poisoning.¹

The pains which have been described in the preceding paragraph, as affecting the limbs as well as the trunk, sometimes exist independently of the gastro-intestinal derangement described by the term colic. They are said to affect more particularly the workers in minium (red oxide of lead), while colic is more prevalent among the manufacturers of ceruse (the subcarbonate). These musculo-neuralgic pains (for they have many characters of rheumatism as well as neuralgia), are frequently most severe at night, affect the joints and the flexor muscles of the lower extremities, and those of the loins, and in the calf of the leg, especially, are accompanied with severe cramps.

In close connection apparently with the affection just mentioned we must regard *lead-palsy*, a form of disease which was known to the ancients, as has been already stated, but which was first thoroughly investigated by M. Tanquerel. Usually attacking those who have been long exposed to the emanations of lead, and who have previously suffered from colic, the paralysis is nearly always confined to the ex

¹ N. Y. Journ. of Med., March, 1856, p. 235.

tensor muscles, and often to those of a single limb or of a single joint. When the extensor muscles on the forearm are paralyzed, the hand assumes a position which has acquired for this affection the vulgar name of *dropped hands*; the like condition of the muscles of the lower limbs renders progression difficult or impossible; aphonia occasionally results from paralysis of the vocal muscles, and utterance is difficult from feebleness of the muscles of articulation. This loss of power is generally followed, sooner or later, by atrophy of the affected muscles, and the permanent bending of the limb by means of the unresisted action of the flexor muscles.

But the most formidable effects of lead poisoning are those manifested by the central organs of the nervous system. They were first fully described by M. Grisolles in 1836, and three years afterwards their history was completed by M. Tanquerel. As in other cerebral affections, sometimes one and sometimes another class of symptoms predominates, delirium, convulsion, or coma giving its peculiar character to the attack. In the delirious variety the intellectual disturbance may be slight, amounting to a mere wandering of the mind, or it may rise to the violence of maniacal delirium. Usually it is continued, but is marked by irregular exacerbations. The convulsive form is the most frequent of all. It has many, indeed most, of the characters of an epileptic paroxysm, is preceded frequently by a giddiness and mental confusion of several hours' duration, and is followed by dulness of perception and intellect, or by raving and violence. This form of attack is very frequently fatal; the patient perishes in a state of coma, or exhausted by the shock to his system. In a third variety, coma, or rather lethargy, is the dominant symptom. The patient is not wholly insensible to external impressions, nor always incapable of expressing himself vaguely, and at times his movements seem to denote that he is in pain. The return of consciousness is gradual, and no recollection of the incidents of the attack remains.

The only lesion which the nervous centres present in fatal cases of lead poisoning with cerebral symptoms, is an apparent hypertrophy of the brain, or at least a state of tension so great that, although there is actually less blood than usual in the cerebral vessels and less effusion in the ventricles of the brain, the surface of this organ has a flattened appearance; and if, before the calvarium is removed, portions of the skull and of the membranes are excised by means of a trephine, the cerebral substance will rise into the opening and even protrude from it.

Most of the sources of lead poisoning which have now been indicated are patent, and their effects are scarcely to be avoided unless unusual precautions are observed by those engaged in the manufacture or the

use of lead ; but there are some among them that act secretly and insidiously, and often undermine health and even destroy life without a suspicion existing of their real character. Lead is a poisonous ingredient in wines. It is now never used to adulterate wine,¹ although it formerly was so for the purpose of correcting the acerbity of many inferior varieties of this liquor. But sometimes wine and other liquors, as beer and cider, become impregnated with lead by running through pipes of this metal, by being kept or served in leaden vessels, or by the leaden pellets (shot) which are used to cleanse bottles, remaining in these latter, and becoming a source of poisonous contamination. Food, particularly when it is acidulous and is cooked or kept in vessels lined or largely soldered with lead, or in earthen vessels glazed with lead, frequently acquires poisonous qualities; and confectionery sometimes is sold which is rendered equally pernicious by the preparations of lead employed to color it. But more than all, water which has dissolved the oxide or carbonate of lead in its contact with reservoirs or pipes of this metal, is a fruitful source of all the forms which have been described of saturnine poisoning. It is well known that in many cities the pipes which supply the houses with water are made of lead, and have been so, in fact, for two thousand years.² Pliny says that water rises to a level with its source when conveyed in leaden pipes.²

It is certain, therefore, that when water thus conveyed produces poisonous effects, it must do so under conditions altogether exceptional. What these are modern science has revealed.

If water is free from saline matter, a hydrated oxide and a bicarbonate of lead are formed and diffused through it, particularly if the free access of air is allowed. Thus, if a piece of perfectly bright lead is placed in distilled water, it rapidly becomes coated with carbonate of lead. Yet this action is prevented by a proportion of saline matter, not exceeding the 15,000th part of the weight of the water. The carbonate, and, according to Mr. Taylor, the sulphate of lime in a still higher degree, prevent the action of water upon lead. If the latter salt forms only the five thousandth part of the weight of the water, no carbonate of lead is produced. The sulphate of lead gradually forms a coating which closely invests the metal, and prevents the production of any oxide or loose crystalline carbonate. Dr. G. B. Wood has suggested, in regard to the saline constituents above referred to, that very probably the sulphate of lime prevents any solution of lead in the water, by the union of its sulphuric acid with any oxide or carbonate of lead that may have been generated, and that at the very mo-

¹ MULDER, the Chemistry of Wine, ed. by H. B. Jones, p. 362. ² Hist. Nat., xxxi. 31.

ment of its generation. He further explains the action of the bicarbonate of lime, by supposing that "one equivalent of its carbonic acid seizes the oxide of lead as fast as formed, and the reproduced carbonate then appropriates the free carbonic acid in the water, which is thus rendered incapable of acting as a solvent to the carbonate of lead produced."

But in considering the manner in which water conveyed in leaden pipes or preserved in leaden vessels is preserved from contamination, it should not be forgotten that the presence of various mineral substances which exert no chemical action, and, also, of organic particles, exercises a protective power. Mr. Pearsall¹ has proved this to be the case, by showing that the quantity of lead varies with substances accidentally and mechanically present in the water, and that the chemical affinities by which the lead is held in solution are so feeble, that the mere presence of foreign bodies may be capable of subverting them.

Poisoning by water contaminated with lead, is probably of more frequent occurrence than is generally supposed, for in some of the most deplorable instances of this accident, the real cause of the mischief remained unsuspected for a long time. This was the case when, in 1848, the illustrious exiles from France who resided at Claremont had nearly fallen victims to their own and their medical attendants' want of suspicion, and, perhaps, to a culpable ignorance on the part of the latter concerning the nature of the symptoms they were called upon to witness.² The water which supplied the palace was the same which had been used for thirty years, and was so pure that it contained only 5.7 grains of solid matters to the gallon. It was brought a distance of two miles through leaden tubes from a natural pool, and originally to a leaden cistern, in the palace, but this had been replaced by an iron cistern, and the pool, which was partly filled with animal and vegetable detritus, was cleansed. The exposure of the interior of the tube to the air during the progress of these changes, must have allowed some disintegration of the crust that lined it, and the removal of the foreign particles from the water must have permitted it to exert all the action upon the lead which its chemical purity entitled it to, and thus an unusual large quantity of lead was found in the water used for domestic purposes. It is interesting to remark that of 38 persons in the family, only 13 were affected, and, of these, three only were seriously ill. Thus it is evident that there are peculiarities of constitution which increase the susceptibility to the saturnine poison, independently of the quantity of lead imbibed.

A case very similar to the above occurred on the Cape Fear River,

¹ Med.-Chir. Trans., xxii. 92.

² Archives Gén., 4ème sér., xx. 283.

in 1853, and is reported by Dr. Anderson.¹ Water of unusual purity was conveyed in a leaden pipe of 2000 feet in length, to a reservoir which supplied the workmen of a saw-mill. Those who used most of it were severely attacked, and ten cases in all, presented unequivocal symptoms of lead poisoning. The water, on being subjected to the test of iodide of potassium, became speedily tinted with an orange-colored precipitate. These, and many similar facts prove, that unless water contains a certain amount of saline constituents capable of forming insoluble compounds with lead, it cannot be safely used as a drink after passing through leaden pipes. If the water, instead of these salts, is contaminated with chlorides (as common salt), it acts readily upon lead, and cannot be taken with impunity.

According to Mialhe, it is by forming a double salt with an alkaline chloride in the stomach, that the preparations of lead become poisonous, for this compound is not precipitated by albumen, and can, therefore, enter freely into the liquids of the economy. Hence the more soluble the salt of lead, the more rapidly does it undergo this conversion, and produce its poisonous effects. The same author suggests, as an explanation of the different degrees to which persons are affected by the same contaminated water, that some consume more salt with their food than others, and thus favor a speedier and more abundant production of the soluble chloride than would otherwise occur.

Treatment of Lead Poisoning.—When an overdose of any preparation of lead is taken, means should be employed to promote its discharge, and then to allay the gastro-intestinal disturbance it may have caused. For the first object, large quantities of mucilaginous drinks containing sulphate of magnesia or soda in solution, and a full dose of ipecacuanha, should be administered. When the stomach has been thoroughly emptied, additional quantities of the soluble sulphate should be given, to act as a chemical antidote to the salt of lead in the bowels, and as a purgative. If there should be severe pain at the epigastrium, warm fomentations with laudanum may be applied, or small doses of the sulphate of morphia frequently repeated, may be given internally. If, as very rarely happens, these measures are insufficient to allay the pain, local depletion may be resorted to. The different methods which have been found successful in the treatment of the chronic poisonous effects of lead, appear to act by eliminating the metal from the economy. Probably a gradual elimination of it is constantly going on by the skin, the bowels and the kidneys, and it is certain that under the influence of remedies directed to these several organs, the quantity

¹ Am. Journ. of Med. Sci., Oct. 1853, p. 374.

of lead discharged by them is increased. The proof of this in regard to the urinary secretion, will be found in the article which treats of iodide of potassium. M. Chatin detected lead in the alvine evacuations; and the large quantity excreted by the skin is shown when a person suffering from chronic lead poisoning is immersed in a sulphurous bath. The skin becomes blackened by sulphuret of lead, which can be removed by soap and water, and, in the course of a day or two, if the experiment is repeated, it produces the same results.¹

In the treatment of saturnine cachexia, the whole of these methods should be employed, whether or not some one or other of the more special forms of lead disorder is present. But it is here especially, that sulphurous baths are of service. The water used should be tepid, and contain five or six ounces of sulphuret of potassium in each bath. The tub itself should be made of wood, and the duration of the bath should be from half an hour to an hour, the skin, meanwhile, being vigorously rubbed with a flesh brush or with a coarse cloth. Finally, the patient should be well washed with warm soapsuds, in order to remove the lead which discolors his skin. This process ought to be repeated as frequently as twice a week, and as long as the skin affords evidence that lead is still contained in the economy. Conjointly with this measure, the iodide of potassium should be administered in doses of from five to fifteen or twenty grains three times a day, and every other day, at least, a brisk saline cathartic should be prescribed.

A special treatment is usually necessary in cases of lead colic, although it has been found that a great many persons suffering from this affection recover if they are removed from the influence of the causes which occasioned the attack, and have the opportunity of resting, and of using an appropriate diet. But where the disease is severe, such negative treatment is not warrantable, and when it is mild it may still be abbreviated and the danger of a relapse prevented by judicious measures. As M. Grisolle has remarked, "various modes of treatment have been recommended, the uselessness and even the dangers of which have been proved by experience, such as antiphlogistics, tobacco, nux vomica, sulphuretted water, alum, water acidulated with sulphuric acid, and revulsives." The elements of the treatment which the most recent observation has sanctioned, are the same as constituted the famous method of La Charité, in 1603, viz., opiates and evacuants. If the state of the tongue and constant sick stomach furnish the indication, an emeto-cathartic (of tartar emetic one grain, sulphate of magnesia, one ounce), should be prescribed. It will sel-

¹ MIALHE, *Chimie Appliquée*, p. 354.

dom or but slightly purge, and purgative enemata must then be directed, consisting of an infusion of senna and jalap, while emollient cataplasms are applied to the abdomen, and at night, a grain or two of opium is given to promote sleep. But the purgative upon which reliance must be mainly placed is croton oil, given in doses of one or two drops, and continued for several days, and even after the complete cessation of the colic. Meanwhile no nourishment should be taken except mucilaginous infusions, whey, or thin broths, and stronger food is not allowable until the function of the bowels is re-established.

It seems to be highly probable that the well-tested efficacy of purgatives in lead colic, depends upon their power of eliminating the saturnine particles contained in the coats of the intestines, and, at the same time, of powerfully exciting these latter to contraction, for the purgatives which are most efficient are those, also, which are most drastic. This view of the subject appears to be strongly supported by the efficacy of electricity in the treatment of lead colic. Mr. Briquet has attempted to show that the pain in this affection is seated not in the intestines, but in the abdominal muscles, and that by means of induced electricity (*faradisation*), applied to neighboring points of them through metallic brushes, he was enabled entirely to dissipate the spasmodic pain of the attack.¹ The intensely severe pain excited by the electrical current could hardly fail of stimulating the intestinal as well as the abdominal muscles, just as cold and heat applied to the surface of the abdomen are familiarly known to excite or to relieve pain in the bowels.

In the treatment of paralysis produced by lead, electricity is also a potent remedy, particularly when the affection has become chronic, and the muscles are more or less atrophied. Meanwhile, however, every means must be employed to purge the system of the poisonous mineral by sulphurous baths and by iodide of potassium, and strengthening dietetic and medicinal measures are also to be prescribed to restore the impoverished blood and the impaired nutrition. As a direct stimulant to the palsied muscles, strychnia was generally used before the employment of induced electricity became so general. It may be prescribed internally, in doses of an eighth or a tenth of a grain, and gradually increased until spasmodic movements begin to be observed in the paralyzed muscles. It may also be used endermically.

The cerebral affections produced by lead-poisoning appear to be very slightly under the control of medicinal agents. If we except

¹ Bull. de Thérap., liv. 54.

opium, which certainly acts with great power in subduing delirious excitement in the maniacal form, there is no other remedy—neither bleeding, nor purgatives, nor blisters, nor cold douches to the head, nor quinia, nor antispasmodics—which appears to exert any decided control over the course of these formidable affections, which are said to be fatal in about one-half of the cases. Indeed, M. Tanquerel, after passing in review the different measures, concludes that better than any of them is “the expectant method based upon the use of low diet and diluent drinks.”¹

To prevent the development of poisoning in those who are engaged in manufacturing or using lead and its preparations, various expedients have been devised, but they all resolve themselves into this, viz., to prevent as much as possible the contact of the saturnine particles with the body. Thus the rooms in which men work should be thoroughly ventilated, flues should be arranged to carry off the vapors produced by heat or by chemical reactions, the grinding of lead should be performed under water, &c. Still more important, but more difficult to obtain, are cleanly habits on the part of the workmen, who should wear over their other clothing a loose garment which they can remove on leaving their work; they should remain in the midst of lead dust and fumes for as short a time as possible; always wash the hands and cleanse the mouth and nostrils with water before eating, and never take their meals in the manufactory; they should use a warm bath and cleanse the skin with soap once a week, keep the bowels free by an occasional dose of olive oil or of castor oil, and on the first appearance of symptoms of impaired health they should resort to medical treatment.

Uses of the Preparations of Lead in Medicine.

INTERNALLY. *Hæmorrhage*.—The combined sedative and astringent properties possessed by the preparations of lead render them peculiarly applicable in this form of disorder; for while they diminish the power with which the heart forces the blood into the lacerated or flaccid vessels, they increase directly the tendency of the blood to coagulate, and restrain its effusion by constricting the walls of the vessels themselves.

The earliest mention, with which we are acquainted, of lead as an *internal styptic*, was in 1764, when it is said to have been used successfully for the arrest of hæmoptysis.² It next was brought into notice by Prof. Barton, of the University of Pennsylvania, who, however,

¹ Op. cit., p. 370.

² Med. Museum, Lond., iii. 449.

refers to Dr. Reynolds, of London, as setting the example of employing it "as a sedative or astringent in dangerous bleedings from various parts of the body." He exhibited the acetate of lead generally in combination with a small proportion of opium, and sometimes of ipecacuanha. "Seldom," he remarks, "have I been disappointed in my expectations of benefit from the medicine, which, of all the articles of the materia medica, seems to me to possess the greatest command over the movements of the arterial system. In no instance have I perceived any dangerous effects, and rarely any temporary inconvenience, from the employment of lead."¹ The approbation which this distinguished man gave to the use of the medicine induced many of his pupils to employ it. Among them, Dr. G. E. Mitchell reported six cases of uterine hemorrhage cured by its means,² and ultimately it became a familiar and habitual remedy in all cases of spontaneous hemorrhage. In 1808, Dr. Ewell, of Washington, D. C., published several cases in which bleeding from the bowels or the uterus, of the most threatening character, was arrested by acetate of lead, given in doses of from three to seven grains every two hours. It was even then remarked by this physician that the advantages of the remedy were more conspicuous when there was excitement than when there was depression of the system.³ It was the remedy on which Dr. Dewees greatly relied in cases of menorrhagia depending upon plethora, after the use of depletion, and in conjunction with cool air and drinks, and a suitable position of the patient. He prescribed it also for uterine hemorrhage occurring during pregnancy, directing two or three grains of it, with opium, every half hour, or an enema containing twenty or thirty grains of the salt and a drachm of laudanum.⁴ Dr. Elliottson urged the administration of acetate of lead, in doses of two or three grains every two or three hours, in different forms of hemorrhage, and did not hesitate to continue it for several days in the same dose, taking care only to keep the bowels open.⁵ More recently we find that still larger doses have been administered, as by Mr. Sweeting, who is accustomed to prescribe five grain doses at intervals of three or four hours, and who gave, in a case of excessive hemorrhage from the uterus, five grains every hour for twelve consecutive hours, with a favorable result;⁶ or by Dr. Lane, of Dublin, who administered ten grains every four hours, for seven days, in a case of menorrhagia.⁷ This gentleman gave the remedy in five grain doses, at intervals of four hours, in a

¹ BARTON'S CULLEN, ii. 21.² COXE'S Med. Museum, 1806, ii. 417.³ Med. Repository, xi. 249.⁴ Dis. of Females, 3d ed., pp. 167, 339.⁵ Pract. of Med., 2d ed., p. 152.⁶ Am. Journ. of the Med. Sci., Oct. 1841, p. 465.⁷ BRAITHWAITE'S Ret., Am. ed., vi. 87.

case of tubercular hemorrhage which no other remedy would control. In passive bronchial hemorrhage, according to Dr. Stokes, nothing can be more striking than its power to arrest the discharge. Indeed, as compared with other internal styptics which act after absorption into the blood, none is so general in its application, nor so certain in its effects. Others have more power in coagulating effused blood, whether upon the external surface of the body, or upon that of the intestinal mucous membrane; but the acetates of lead alone combine the qualities which, as stated in the preceding paragraph, tend to prevent the vessels themselves from pouring out their contents.

Owing to its possession of these peculiar virtues, acetate of lead was at one time used in the treatment of *aneurism*. In the hands of Dupuytren, who employed it in aneurism of the great vessels, it to some extent fulfilled the expectations which were entertained concerning it. Several cases in which the diagnostic marks of aneurism of the thoracic vessels were very clear, were subjected to this treatment. It had the effect of calming the action of the heart, reducing the pulsations and the size of the aneurismal tumor, and diminishing the dyspnoea and bronchial secretion.¹ Bertin also states that he employed the remedy with some success.² Hope says that his experience is in its favor;³ Walshe explains how, in sacculated aneurism, it may, like other astringents and sedatives, promote coagulation of the blood.⁴ But, on the other hand, Dr. Bellingham urges that "the administration of acetate of lead is calculated to prove rather detrimental than otherwise; and as aneurism of the aorta is not cured by 'coagulation in the aneurismal sac,' its administration with this object, even if it had the power of causing coagulation, is absurd."⁵ The sacculated form of aneurism, we do not hesitate to affirm, is cured, and can only be cured, by coagulation of the blood in the sac; and in so far as acetate of lead and other sedatives and astringents promote this operation, they contribute to the cure. That form, on the other hand, which consists in a more or less symmetrical and local distension of the whole artery, must be cured, if at all, according to a different mechanism, and one in which no mere astringent, certainly, can exert a salutary power. In any given example of aneurism of the great vessels of the trunk, it is perhaps impossible to anticipate the effects of treatment, since the physical conditions vary extremely in different cases. The shape of the aneurismal sac, the size and direction of its communication with the artery, the state of

¹ Archives Gén., 3ème sér., v. 443.

² Mal. du Cœur, p. 153.

³ Diseases of the Heart, Pennoek's ed., p. 446.

⁴ Diseases of the Chest, 2d ed., p. 772.

⁵ Diseases of the Heart, p. 619.

its walls, and, finally, the quality of the blood in reference to coagulation, all of these elements may modify or reverse the normal effects of a given mode of treatment.

Acetate of lead is mentioned by several writers of authority among the sedatives which may be employed in *hypertrophy of the heart*. Brachet has reported several cases in which he found reason to extol its virtues;¹ but, as in every instance, it was associated with digitalis in the treatment, the share which the former medicine had in alleviating the symptoms can hardly be appreciated. The sedative influence of lead upon the heart is too well determined by the concurrent testimony of competent witnesses, for us to entertain a doubt that it may palliate the violent palpitations which accompany hypertrophy; but it may well be doubted whether we are justified in continuing to use for an indefinite period a medicine which, sooner or later, must impair the health. As for those cases in which it has seemed to diminish the bulk, as well as the excessive action of the heart, we must not forget that the latter of these always subsides under the influence of repose alone, and that the former, if estimated during violent action, appears to be greater than when the congestion of the organ has been reduced.

Bowel Affections.—In this country, it is probable that acetate of lead is used more than anywhere else in the treatment of sporadic *dysentery*, for the remedy here first became popularized among practitioners of medicine. It was not, however, at the time of its introduction, a new remedy for the disease. For Ettmüller placed sugar of lead above all other remedies in the treatment of dysentery, and also, in the last century, Moseley described the singular efficacy of glysters containing acetate of lead, in removing inveterate and harassing tenesmus succeeding long continued dysenteries and diarrhœas, where bloody mucus, or sometimes blood, and sometimes purulent matter, is perpetually voided, with intolerable soreness about the anus.² In 1807, Hegewisch said that in chronic bowel complaints no other remedy was comparable to lead.³ Before 1820, Dr. Robert Jackson used a solution of this salt as a local application to the excoriated anus, and prescribed it internally in an acute form of the disease which he denominates “erysipelatous,” and he says of the remedy: “It is not dangerous; on the contrary, it is of great benefit.” He also gave it internally in chronic dysentery.⁴ In 1822, Dr. Harlan, of Philadelphia, published seven cases of acute dysentery out of many which he had treated with acetate of lead and

¹ Bull. de l'Acad. de Méd., xx. 1204.

² On Tropical Diseases, p. 404.

³ RICHTER, op. cit., iv. 638.

⁴ On Febrile Diseases, &c., 2d ed., ii. 46, 50, 61.

opium. In the majority of instances, he found it to check the bloody stools, to allay intestinal irritation, and to relieve in a very prompt manner tormina and tenesmus.¹ In 1826, Dr. T. D. Mitchell, also of Philadelphia, furnished an equally favorable account of the use of the medicine in dysentery, hemorrhage from the bowels, and cholera infantum.² In 1825, Dr. Burke, of Dublin, treated upwards of two hundred and fifty cases of dysentery with this medicine. He thus describes the condition in which it appeared to be most useful: "When the patient is low and weak, either from the continuance of the disease, or from previous bad diet; when the abdominal pain is not constant, nor much increased on pressure; when there is little or no fever; and when the tenesmus and exhausting flow of blood from the intestines form the principal subject of complaint—in these cases I know not any other medicine of equal value."³ Much more recently, in 1851, Dr. Batchelder, of New York stated that, although he had had a very large experience of the use of this medicine in dysentery, he in no case had known any ill consequences to follow its use.⁴ It may be added that in dysentery of children acetate of lead is recommended by Drs. Condie and J. F. Meigs, and in chronic diarrhœa by Dr. West and Dr. Willshire, of London.

These citations, especially that from Dr. Burke, show the value of the remedy, and the conditions of its safe and useful application to dysenteric affections. As a specific, it cannot be recommended; but in sporadic cases of dysentery, when the bowels have been cleansed of fecal accumulations by means of calomel, followed by saline cathartics, the utility of the medicine is, we think, incontestable. It should be given in doses of one or two grains, every three or four hours, combined with a quarter of a grain of opium, and its action sustained by enemata of at least half a pint of an astringent vegetable infusion or decoction, or of a solution of subacetate of lead, in the manner presently to be described.

In tropical dysentery, it is probable that this agent is of inferior value, on account probably of the hepatic complications which are so frequently observed in that form of the disease. Recent writers who have had sufficient experience of this affection in British India, do not esteem very highly its treatment by acetate of lead, except in the hemorrhagic form, where its great value is fully admitted.⁵

¹ Amer. Med. Recorder, v. 655.

² N. Amer. Med. and Surg. Journ., i. 70.

³ Edinb. Med. and Surg. Journ., xxvi. 56.

⁴ N. York Journ. of Med., July, 1851, p. 39.

⁵ MOREHEAD, Disease in India, i. 573. MARTIN, Influence of Tropical Climates, p. 239.

The *subacetate* of lead has also been used with marked success in acute and *chronic diarrhœa* and dysentery, by many physicians, as one element of the treatment, and by some as the only medicine. In 1850, M. F. Barthez reported a number of cases in which enemata of a pint of tepid water, containing from one to two drachms of the solution of subacetate of lead, and repeated three or four times a day, or oftener, if the number of stools rendered it necessary, arrested and cured the disease. In some cases, as much as an ounce of the saturnine solution was administered in the course of twenty-four hours. In no instance did the patients experience any effects due to the absorption of lead.¹ The same plan of treatment has also been followed by M. Boudin, in between five and six hundred cases of diarrhœa, dysentery, or epidemic cholera, with the most satisfactory results.²

Dr. Archer, of Maryland, was probably one of the first who used acetate of lead in the treatment of chronic diarrhœa, although the astringent properties of the medicine are so evident, that one cannot but feel surprised at its not having sooner come into general use.³ Dr. Bardsley used it to control the diarrhœa of typhoid fever, Dr. Graves in cases apparently of the same description, and Dr. Oke, of Southampton, in exhausting diarrhœa following parturition, and in chronic mucous discharges from the bowels.⁴ In France, M. Tostain has published many cases of intestinal flux in which a solution of acetate of lead, without opium, was given with marked success.⁵ Dupuytren used this preparation in epidemic cholera, but it was Dr. Graves, of Dublin, by whom it was first more generally made known (in 1832) as an efficient means of checking the premonitory diarrhœa of cholera, and the alvine discharges in the fully formed disease. He prescribed about two grains of acetate of lead and one-twelfth of a grain of opium every half hour, until the rice water discharges from the stomach and bowels began to diminish.⁶ The same treatment has been employed by Dr. Parkes and other physicians, but while it appears to stay in some measure the evacuations, it exerts but little influence on the final result of the disease. In the Medical Report to the London Board of Health, in 1855, which contains the statistical results of about 3,000 cases of cholera treated by various methods, acetate of lead seems to have been used in an extremely small proportion of the cases, and even then combined with opium. It appears,

¹ Actes de la Soc. Méd. des Hôpitaux de Paris, 2ème fasc., p. 59.

² TROUSSEAU and PIDOUX, Thérapeutique, 4ème éd., i. 148.

³ Med. Repository, iii. 237.

⁴ BRAITHWAITE's Retros. (Am. ed.), viii. 167.

⁵ Abeille Méd., xi. 281, 290, 332.

⁶ Clinical Med., p. 697.

therefore, not to have retained any large degree of the confidence that it once enjoyed.

Acetate of lead, according to Moultrie, was used in the last century to moderate diarrhoea in certain cases of *yellow fever*; and Dr. Irvine, of Charleston, thought it applicable in all stages of the disease, in the first, as a sedative, in the second as an astringent to restrain hemorrhage, and in the decline as a tonic. But the general sentiment of those who have used the medicine in this affection is unfavorable to its usefulness, except in some cases marked by a hemorrhagic disposition, in which it *appeared* to be beneficial.¹ Evidently, in yellow fever, and also in cholera, the chief influence of lead must be limited to the alimentary canal. The astringency of the medicine may to some extent prevent the exudation of blood in the one case, and of serum in the other, but in neither can it probably influence the state of the blood upon which these effusions depend.

The astringency of this salt has been found useful in some cases of *tympanitis*, depending probably upon atony of the muscular coat of the intestine. It has been highly recommended by Dr. Bardsley and Dr. Graves in the flatulent distension of the bowels occurring in typhoid fever; and Mr. Baddley, in a case of obstinate tympany consequent upon over-active purgation employed for the relief of colic.²

At one time acetate of lead was held to be a valuable remedy in *pulmonary consumption*. Richter says that it had long ago been used in this affection, by Seerup in 1700, Hundertmark in 1741, and even in the seventeenth century by M. Ettmüller, while in the present century it was recommended by Hildenbrand, Horn, Amelung, and Kopp, who gave it the title of *solamen phthisicorum*. According to the last-named writer, its effects are these: it diminishes the sputa and perspiration, and the frequency of the pulse often as much as ten beats in a minute. In "mucous and purulent consumption of the lungs" it often produces wonderful effects, but in ulceration of these organs it is of no use, and often, indeed, is mischievous.³ Even Lewis, while speaking timidly of the medicine as a dangerous one, admits that it has the power of "restraining the colliquative sweats attending phthisis and hectic fevers."⁴ Still later we find Dr. John Latham saying, "not only in hemorrhages, but in colliquative diarrhoeas and hectic perspirations, and more especially in that semi-purulent expectoration which too often terminates in pulmonary ulceration and consumption, have I given the superacetate of lead in very large quantities, with very considerable advan-

¹ LA ROCHE, on Yellow Fever, ii. 675.

² Lancet, Jan. 1848, p. 44.

³ RICHTER, op. cit., iv. 632.

⁴ Mat. Med., ii. 236.

tage.”¹ Several years later Fouquier, referring to this subject, said, “in attempting to cure pulmonary consumption with acetate of lead, we have found in this salt a precious remedy for colliquative sweats.”² Thus, gradually, as pathological anatomy and physical diagnosis rendered the differences apparent between tubercular phthisis and chronic bronchitis, the true value of the medicine became established, and showed that its power of diminishing secretion, which could only be palliative in the former, is really curative in the latter affection. Dr. Stokes saw abundant evidence of its astringent action on the capillaries of the lungs,³ and Dr. Henderson, “that it is a remedy by far the most worthy of reliance in bronchitis attended with profuse secretion.”⁴ Indeed the only morbid element, except increased frequency of the arterial pulse, which acetate of lead controls, is secretion, and this it does almost as effectually in diseases which present in a certain degree the inflammatory element, as in those bronchial fluxes which involve no degree of inflammation. In whooping-cough, attended with excessive secretion into the bronchia, and still more in the chronic forms of bronchial catarrh to which old persons are subject, and those affected with emphysema and valvular disease of the heart, this medicine is often in the highest degree salutary.

Acetate of lead has been used in the treatment of various *nervous diseases*. Dr. Rush states that by its means he cured several *epileptic* patients under the age of puberty, but that it was unsuccessful in adults.⁵ Dr. Spence relates the cure of the disease in his own person by taking the medicine in small and repeated doses until its toxical effects were produced.⁶ Dr. Agnew, of Gettysburg, cured a boy seven years old of the disease,⁷ and Dr. Eberle one in which the disease was of eight years’ standing.⁸ Dr. Gardner found it a safe and efficient remedy in many cases of *neuralgia* of the superficial nerves of the face, head, and trunk, and even of the abdominal viscera.⁹ Mr. Willey used it with success in some cases of *hysteria* and *chorea*.¹⁰ It is so well known that nervous affections frequently get well under the most opposite methods of treatment, under any cause, in fact, which disturbs the existing condition of the system, that cures of them must sometimes have followed the administration of the acetate of lead; but on examining the sum of experience of this sort possessed by the medical world, it will be found to be trivial indeed. Certainly, there are no

¹ Trans. Lond. Coll. Phys. (1815), v. 341.

³ Dis. of the Chest, p. 125.

⁵ COXE’S Med. Museum, i. 60.

⁷ Med. Repos., ix. 34.

⁹ Lond. Med. and Phys. Journ., lxxv. 32.

² Bulletins de la Faculté (1819), ix. 441.

⁴ Lond. Med. Gaz., May, 1840, p. 263.

⁶ Ibid., ii. 150.

⁸ Therapeutics, p. 280.

¹⁰ Med. Repos., ix. 266.

indications by which the probability of their cure by this substance can be estimated, and it is, therefore, one of the very last which should be chosen in the list of remedies for nervous disorders.

EXTERNAL USE.—The *subacetate of lead* was first introduced into medical practice by Goulard, a surgeon of Montpellier, in 1746, as a secret remedy for the cure of all sorts of exuberant granulations, indurations, and other effects of inflammation, and it was not until five years later that he published the method of preparing it. In his treatise¹ he shows that the external use of lead was anciently common in various diseases, and that even within two centuries it had been used by the most eminent surgeons. He then sets forth the utility of lotions, ointments, and plasters, made with it, in contusions, burns, wounds, abscesses, ulcers, cancers, sprains, gout and rheumatism, various cutaneous affections, ruptures, piles, &c. From the time of Goulard to the present, these preparations have continued to be used wherever an astringent and sedative action is required, to allay pain and inflammation, to lessen discharges, to constrict flaccid tissues, and promote the absorption of morbid products. Whenever they are applied to the denuded cutis, or to a mucous membrane, it is prudent that their use should not be too long continued, in consequence of the symptoms of lead poisoning which they occasionally produce.

Sheet lead has sometimes been employed as a dressing for ulcers, and *leaden wire* as a ligature for arteries, but these uses of the metal are now almost obsolete.

An ointment made with *carbonate* of lead is occasionally used as an application to burns, scalds, excoriations, cutaneous eruptions, and superficial ulcers, but the dangers of its absorption are thought to be greater than in the case of other saturnine compounds. These, and especially the acetate and the subacetate, in solution, are applied to a great variety of useful purposes, some of which, as examples of the rest, may here be cited. It should be borne in mind that the last named preparation is the more powerful of the two, and that it is commonly used in the form of *diluted solution of subacetate of lead*. A solution of one drachm of the acetate to eight ounces of distilled or soft water, is of the strength ordinarily required.

These solutions, applied on lint, soft cloths, or with bread crumbs, are used to allay inflammatory action after bruises, excoriations, sprains, or fractures; to prevent or moderate the tendency to suppuration in phlegmonous inflammations and enlarged lymphatic glands;

¹ A Treatise on the Effects and Various Preparations of Lead, &c. London, 1784, with the epigraph *Redeunt Saturnia Regna*.—VIRG.

and to subdue cutaneous eruptions, such as erysipelas, erythema, herpes, eczema, &c. Bretonneau recommended a saturated solution of acetate of lead in wine vinegar to be applied to the inflamed parts in acne rosacea, by means of a camel-hair pencil, and repeated night and morning at first, but afterwards at longer intervals.¹ Irritable *ulcers* and excoriated surfaces are frequently dressed with a solution of the acetate, or with the ointment of the subacetate of lead. The efficacy of both preparations is increased by the addition of acetate of morphia, in the proportion of about one grain to the ounce. When, as is sometimes the case, a mucilaginous solution of either acetate of lead is required, flaxseed or the pith of sassafras should be chosen to prepare it, for, according to Dr. Wood, the mucilages of slippery elm and of quince-seeds cause a precipitation of the lead.

In inflammation of *the eye*, with ulceration of the cornea, saturnine solutions should be avoided, as the particles of the salt employed may become permanently impacted in the ulcer and produce incurable opacity of the cornea. In acute catarrhal conjunctivitis, a solution of one or two grains of acetate of lead in an ounce of rose-water, or of sassafras mucilage made with rose-water, is an excellent, and often a sufficient remedy. The more chronic forms of ophthalmia, particularly that attended with a granular state of the conjunctiva, in persons of a strumous habit, are said to have been successfully treated by the application of very finely-powdered acetate of lead to the everted lids by means of a moistened camel-hair pencil. M. Buys, with whom this practice originated, directs that all of the undissolved salt should be removed before returning the lid to its place. He represents the operation to be less painful and much more permanent in its effects than that with the nitrate of silver.² Dr. Vetch, of London, represented the undiluted solution of the subacetate as very efficacious in purulent ophthalmia.

A *gargle*, composed of eight or ten grains of acetate of lead dissolved in six ounces of water or mucilage, has been recommended as a means of preventing the development of inflammation of the tonsils; also in pseudo-membranous and aphthous conditions of the mouth and fauces, and in mercurial salivation. Dr. Ewell, of Washington, originally employed this solution for the last-named purpose.³ It has also been proposed and employed to remedy this troublesome accident by M. Bonnardière and M. Sommé, though Cullerier speaks of it as having been unsuccessful in his hands.⁴ When used as a mouth wash, it

¹ Bull. de Thérap., xxxi. 285.

³ Med. Repos., xi. 252.

² Annuaire de Thérap., 1850, p. 232.

⁴ Arch. Gén. (1823), i. 483.

gradually renders the teeth slate-colored, or entirely black, owing to the formation of a sulphuret of lead. The stain may be removed by a solution or dentifrice, containing tannin, applied with a firm brush.

A very common use of these salts is in astringent *injections*, for vaginal leucorrhœa, and they are often very efficient in curing this affection. Yet they are less frequently successful than alum. In gonorrhœa, or rather in gleet, they are of less value than the salts of zinc.

A solution of the *nitrate of lead* (gr. x to ʒj) has sometimes been used as a discutient in the same manner as the acetates, but it is more useful as a deodorizing agent, to correct the fetor arising from gangrenous sores and offensive discharges from the nostrils, ears, vagina, &c.

Mr. Druitt has recommended the solution of nitrate of lead as an efficient remedy for non-constitutional *ozæna*.¹ The nostril is directed to be first washed thoroughly with warm water by means of a syringe holding at least two fluidounces; after which, another syringeful of water, containing five or six drops of the solution, should be injected. This operation ought at the first to be repeated daily or every other day. If severe pain ensues, the following injection should be weaker. In a case which had resisted every known treatment employed by us during two years, this method effected a cure in the course of a month.

Iodide of lead is thought to possess discutient powers in a higher degree than the other preparations of this metal. An ointment, made by rubbing together one part of iodide of lead and seven of lard, appears in many cases to exert discutient powers. In two instances of hard and painful tumor of the mamma, with retraction of the nipple, the enlargement and pain subsided under the influence of this application. In cases of enlarged cervical glands, we have seen it cause a great diminution of the swelling. As an application in the advanced stages of *tinea capitis*, it has been recommended by Dr. Neligan. O'Shaughnessy, Velpeau, and Martin, have given it *internally*, and the last named gentleman states that he cured two cases of enlarged spleen, one of them presenting the largest spleen he ever saw, by this method of employing the remedy.²

The *cerate* of the subacetate of lead is used in the same cases to which the solution is applicable, but is most generally confined to those in which it is desirable to protect an irritated part against external impressions, and at the same time to promote its healing. It is an excellent dressing for blistered surfaces that are indisposed to heal

¹ Times and Gaz., Oct. 1858, p. 417.

² Influence of Tropical Climates, p. 289

Diachylon, or lead plaster, when spread upon cloth, is employed for the purpose of protecting inflamed parts from pressure and from the air, promoting the absorption of effusions into the joints, and also by surgeons for drawing together the edges of wounds, ulcers, &c., and giving support to parts. For surgical purposes, it is rendered more efficient by the addition of resin, and then constitutes *adhesive plaster*. An ingenious application of the latter has been made by Dr. David Gilbert, who first used it as a means of making extension and counter-extension in fractures of the thigh.¹

Soap plaster and *soap cerate* are used, like lead plaster, to make a mild dressing and support for inflamed parts, to discuss the swelling of strumous glands, of chronic inflammation of the joints, &c. &c.

ZINCI ACETAS.—ACETATE OF ZINC.

DESCRIPTION.—Acetate of zinc is obtained by decomposing acetate of lead in solution by means of granulated zinc. It is a crystalline salt, usually occurring in white, transparent, rhomboidal plates, which effloresce in a dry air. It has no odor, but an astringent, metallic taste. It is easily soluble in water.

ACTION AND USES.—The local action of acetate of zinc is that of an astringent and irritant. When taken internally in large doses, it occasions vomiting, and might probably be used in the same cases to which sulphate of zinc is applicable.

Acetate of zinc is seldom or never used as an internal medicine. Topically it is applied in all cases of excessive or altered secretion of mucous membranes requiring the use of an astringent; in ophthalmia and gonorrhœa, however, more than in all other analogous complaints. In the former of these affections a solution of one or two grains of the salt in an ounce of mucilage of sassafras made with rose-water, or in the latter solvent only, forms an excellent collyrium. In gonorrhœa, after the acute stage, injections of a solution of acetate of zinc, of the strength just indicated, is one of the best that can be used.

¹ Am. Journ. of Med. Sci., Jan. 1851, and Jan. 1858, p. 105.

ZINCI CARBONAS PRÆCIPITATUS.—PRECIPITATED CARBONATE OF ZINC.

DESCRIPTION.—This is an artificial preparation intended as a substitute for the native carbonate, or calamine. It is prepared by mixing together hot solutions of sulphate of zinc and carbonate of soda, by the mutual decomposition of which the officinal carbonate of zinc, in reality a subcarbonate, is obtained. It is a fine, white, loose powder, feeling soft when rubbed between the fingers, and without smell or taste. It is readily soluble in acids.

ACTION AND USES.—Carbonate of zinc is not given internally, and its topical application is confined to those excoriated or inflamed surfaces which it is desirable to protect from the contact of the air, and moderately to constrict. Hence, in powder, it is very useful in healing blisters which resist milder applications, to prevent the friction of parts which occasions *intertrigo*, and to cure this abrasion when it is produced. In the form of a cerate (CERATUM ZINCI CARBONATIS) it may be used for the same purposes, and applied to the inflamed edges of the eyelids in psorophthalmia, to cure or prevent the excoriation of the upper lip by acrid mucus from the nostrils, to heal chaps of these parts and of the hands, and slight local irritations about the nipples, the anus, or the genital organs.

ZINCI SULPHAS, vid. *Emetics*.

VEGETABLE ASTRINGENTS.

ACIDUM TANNICUM.

DESCRIPTION.—The name of tannin, or tannic acid, is applied to vegetable products which differ among themselves in many respects, but agree in producing a green or blue-black precipitate with the persalts of iron, and in forming an insoluble precipitate with gelatinous solutions. Tannin is a constituent of many perennial plants, and is found principally, but not exclusively, in their bark and roots, and usually in intimate combination with coloring matter. As already stated, it differs in some secondary qualities, according to the source from which

it is obtained; thus, the tannin of galls is not identical with that of catechu, kino, or cinchona, the first differing from all the rest in being convertible into gallic acid on the exposure of its watery solution to the air. The proportion, also, of tannic acid contained in different astringent vegetables is different. The following is a list of the principal medicinal substances of this class, and the proportion of tannin in each:—

Kino	70 per cent.	Uvæ ursi	36 per cent.
Oak galls (Guibourt) .	65 “ “	Pomegranate bark . .	19 “ “
Catechu (Davy) . . .	51 “ “	Tormentil	18 “ “
Krameria	43 “ “	Oak bark	16 “ “

Official tannic acid is prepared by acting with ether upon powdered galls, and evaporating the product. It is a whitish or yellowish-white substance, without smell or bitterness, but of an intensely styptic taste. It is soluble in water, dilute alcohol, and ether; its solution reddens litmus paper, and it combines with alkalies to form salts. It precipitates starch, albumen, and gelatin, the soluble salts of iron, lead, and copper, nitrate of silver, the vegetable alkalies, tartar emetic, carbonate of ammonia, &c. Gallo-tannic acid gives a bluish-black precipitate with the sesquisalts of iron, but the tannic acid of kino, catechu, rhatany, and some other astringents, furnishes a greenish-black or grayish-black color with the same salts.

ACTION. On Animals.—Mitscherlich introduced half an ounce of tannic acid, dissolved in an ounce and a half of water, into the stomach of a rabbit of medium size. The animal displayed signs of great exhaustion, breathed laboriously and hurriedly, the heart's pulsations were very feeble, and the extremities were paralyzed. Death took place in twenty hours. On dissection, the gastric mucous membrane was gray and lustreless, and in some places softened; the urine gave a greenish-blue precipitate with the chloride of iron, proving the presence in it of tannic acid. From this and other experiments Mitscherlich concluded that tannic acid enters into chemical combination with the epithelium and vascular layer of the gastric mucous membrane, or rather with the albumen and gelatin which they contain; for if the acid be added to either of these substances, or to milk, it coagulates them, and, as regards the former, if the union is complete, they are no longer competent to play any part in the living organism. But this effect only arises when a great excess of the acid is present.¹

On Man.—The astringent action of tannic acid upon the mouth and fauces has already been referred to. The rapidity of this action appears to be greater than can be explained by supposing it to be che-

¹ Lehrbuch, i. 241.

mico-mechanical merely, as Cavarra would have it.¹ But, however produced, it is remarkably persistent, and is due in part, at least, to the coagulation of the mucus already secreted, and to the constriction of the orifices of the follicles which naturally preserve the moisture of the buccal mucous membrane.

When taken internally, in doses of one, two, or more grains daily, it appears to increase the appetite and produce constipation. Mitscherlich states that this condition is not usually persistent, for he has frequently administered from ten to twenty grains three times a day, and that the constipation produced by it has usually ceased spontaneously in the course of two or three days. No special derangement of the human stomach appears to have been caused by it in any dose, for Dr. Burns, of Glasgow, mentions, in his work on midwifery, that it has been recommended in chlorosis in doses of one hundred grains daily! (*Alison.*)

Upon the stomach its action, at least directly, must be to diminish more or less the secretions of the mucous membrane, if it is taken in large doses. But, practically, in moderate doses it is found to increase the appetite, although the manner of its doing so is uncertain. Clarus maintains that its action on the stomach containing no food is to precipitate the pepsin and interfere with the digestive process; and he alleges in support of this opinion, that tea and coffee, which both contain tannin, impair instead of strengthening the digestion.² The theory is probably as untenable as the statement upon which it is based; for all mankind who use the beverages referred to, attest that they render the process of digestion easier.

According to Clarus, tannic acid coagulates the mucus of the intestinal canal, and the greater portion of it is evacuated with the feces united with albumen, or else unchanged, or converted into gallic acid. He is also of opinion that most of the effects which have been held to prove the absorption of tannic acid are really secondary, and depend upon an improved nutrition consequent upon the improved condition of the intestinal mucous membrane. In this way, particularly, he explains the influence of the medicine upon certain morbid discharges which it modifies or controls. Yet he cannot refuse to admit a more direct and immediate action resulting from the absorption of tannic acid; for hemorrhages and various morbid secretions are sometimes controlled with great promptness by the medicine.

But as tannic acid coagulates albumen, it is difficult to understand how it can enter the circulation or retain its properties in the midst of an albuminous fluid like the blood. Besides which, we know that

¹ Bull. de l'Acad., i. 285.

² Arzneimittellehre, p. 273.

it is excreted with the urine, not in its original condition, but converted into gallic acid. Clarus has supposed that the precipitate formed with albumen by a saline solution of tannin, may be rendered absorbable by fat; for he found that on agitating such a solution with an animal oil, a complete emulsion was formed, so complete, indeed, that hardly any separation of its parts took place in the course of half an hour. This fact he made practical use of in the administration of cod liver oil.

Without some such medium of transport, it is difficult to conceive the possibility of tannic acid entering the blood. Indeed, Buchner, wholly denying that it can do so, attributes all its efficacy in cases of hemorrhage, to the gallic acid into which, he says, it is converted. But here the difficulty occurs, that gallic acid itself is but slightly astringent. How, then, does it, when given internally, or produced from tannic acid in the stomach, exert a styptic power. To do so, as it unquestionably does, it must, in its passage through the blood, acquire qualities that it did not originally possess. Mr. Headland supposes that in this liquid it is transformed into tannic acid by the addition of the elements of grape sugar, which is continually forming during the blood processes connected with respiration.¹ According to this view, the gallic acid excreted with the urine is derived partly from that which is originally absorbed from the stomach, and partly from the reconversion of the newly-formed tannic acid into gallic acid and sugar. It will be observed that the hypothesis of Clarus and Headland do not mutually exclude each other. Either of them is possible, but the former requires the co-operation of fatty matter in the stomach, where it is not always present.

USES.—*In impaired digestion* accompanying chronic diseases, Dr. S. C. Alison found tannic acid very efficacious. Symptoms of dyspepsia disappeared under its use, the appetite increased, flatulence and the sense of distension were abated at the same time, and in some cases of constipation depending upon debility, the bowels actually became more free.² In this indirect manner the medicine becomes a tonic, improving the color, strength, and secretions, and, according to Dr. A., in cases of rickets, contributing materially to render the bones solid. He also found it useful in cases of nervous debility, languor and excitability, when combined with camphor, hops, or hyoseyamus. Clarus considers it a peculiarly useful medicine for small children affected with acidity of the primæ viæ, aphthæ of the mouth, vomiting, diarrhœa, and progressive emaciation. In *chronic diarrhœa* Alison gave it in a solid form with more

¹ On the Action of Medicines, p. 344.

² Lond. Journ. of Med., ii. 5.

success than any other remedy, especially when the disease appeared to be maintained by a relaxed condition of the mucous membrane. The chronic diarrhœa of drunkards is of this description. In fact, in all cases of habitual and wasting discharges from the bowels unconnected with active inflammation, no remedy is more effectual. In lientery, chronic dysentery, cholera-infantum, cholera morbus, the decline of Asiatic cholera, the diarrhœa of intestinal tuberculosis, of protracted typhoid fever, &c., it will be found more useful than any other remedy of its class, except, perhaps, the acetate of lead.

The effect of tannin upon the secretion from the *bronchia* and from tuberculous cavities in the *lungs*, is often distinctly marked, so much so, indeed, that in many cases of chronic bronchitis with a profuse discharge of pus and mucus, no better remedy can be employed with a direct reference to this symptom. Even when cavities in the lungs exist, their progress appears to be stayed in some instances by the influence of the medicine in limiting the disintegration of their walls, and, at the same time, the patient being less harassed by cough, enjoys more repose, and is enabled to gain strength and flesh. When the sputa are habitually mixed with blood, it speedily disappears under the influence of tannic acid. It has been found useful also in *whooping-cough*, in which it probably affords relief by limiting the amount of secretion into the bronchial tubes.¹ It is also one of the best means of moderating the excessive *sweats* which attend the last stage of phthisis and other exhausting diseases, and that habitual cold damp upon the skin of persons of a soft, weakly constitution. (*Alison*.) Charvet relates several striking examples of its efficacy.²

The various forms of *hemorrhage* are, however, the morbid conditions in which the virtues of the remedy are most conspicuously displayed. It appears to have been first used in cases of this description, for the cure of uterine hemorrhage, by Italian physicians. In 1827 Porta published several cases of mênorrhagia in which its efficacy was very marked, and he at the same time stated that it had no effect when uterine hemorrhage depends upon organic causes.³ Shortly afterwards these accounts were confirmed by Ferrario, who found the medicine very useful in passive hemorrhages of the uterus, and by Cavalier, who, like his predecessors, called attention to the innocuousness of tannin even in large doses and when the stomach is somewhat irritable.⁴ The appropriate cases for its use are stated by him to be those of passive hemorrhage, those also in which the loss of blood has

¹ FRANK, *Magazin für Arzneim.*, iii. 901.

³ *Arch. Gén.*, xiv. 427.

² *Bull. de Thérap.*, xviii. 287.

⁴ *Ibid.*, xix. 589.

long continued, and induced a state of general debility, and those, finally, in which the congestive tendency has subsided, or has been appropriately treated. This view has been substantially confirmed by Dumare,¹ Alison, and other recent writers, and is applicable to hemorrhages from other organs than the uterus. Dr. Rees, speaking of *hæmaturia* depending upon malignant disease of the kidney, advises tannic acid to be given in alternate doses with the muriated tincture of iron.² He prescribes from four to eight grains three times a day. In passive hemorrhage from the *stomach* and *bowels* this remedy is still more efficacious. When the stomach is the seat of the discharge, a large dose should be given at once in solution; but if the intestinal canal is presumed to be its source, the pilular form of the medicine is to be preferred. In the latter case it should be associated with acetate of lead or opium, or both of these agents combined. M. Latour highly extols the efficacy of tannin in *hæmoptysis*. In one case, in which other astringents had failed, it perfectly succeeded; and in three others it was equally successful, but in these the hemorrhage was slight.³

Among other internal diseases, tannic acid has been employed to cure *intermittent fever*, and as an *anthelmintic*, but for these purposes it has no peculiar claim to confidence.

Externally.—As a local astringent, tannic acid may be used for nearly all the purposes to which any one of its class is applicable. Homolle has proposed it as a means of preventing the development of *variolous pustules* upon the face. He used successfully a solution of one part of tannin in four parts of tincture of benzoin.⁴ Finely pulverized tannin, used as a snuff, has been recommended in *chronic coryza*, by M. Trousseau. Mr. Druitt recommends very highly, for *sore nipples*, a solution of five grains of tannin in an ounce of water, to be applied to the part, and covered with oiled silk.⁵ For itching excoriations about the anus and scrotum, which so much infest old men, he used it with benefit. Van Holsbek, also, has found a solution of one part of tannin in sixteen of glycerin very efficient in promoting the cure of fissure of the anus, when applied by means of a tent introduced into the rectum night and morning.⁶ It has also been used with success to prevent *prolapsus ani* and the extrusion of *hæmorrhoids*, and to heal these when in an irritated state, as well as to promote their cure while susceptible of the action of astringents.

Mr. Druitt recommends it for the cure of *aphthous ulcers* of the mouth,

¹ Bull. de Thérap., xxiii. 72.

² Lond. Med. Gaz., July, 1851, p. 48.

³ Am. Journ. of the Med. Sci., xxvi. 201.

⁴ Annuaire de Thérap., 1854, p. 214.

⁵ Am. Journ. of the Med. Sci., Jan. 1845, p. 192.

⁶ RANKING'S Abstract (Am. ed.), xxv. 148.

and for moderating *mercurial salivation*; it is also a very efficient means of reducing *sponginess of the gums*, curing a relaxed condition of the *uvula* and the *pharyngeal mucous membrane*; and, according to Mr. D., it is most of all to be depended upon as a remedy for toothache produced by caries. After scarifying the gum with a fine lancet, a piece of cotton imbued with a solution of a scruple of tannin and five grains of mastich in two drachms of ether is to be placed in the cavity. A strong solution of tannin has also been employed with benefit in acute and chronic *conjunctivitis*, particularly when the bloodvessels are largely distended, either generally, or locally as in *pannus*, and when subconjunctival effusion exists.

As an external application to the skin, when an astringent remedy is required, Mr. Alison thinks it is of special excellence. He used an ointment of it with remarkable benefit as an application to *psoriasis*. But it can, of course, only be subsidiary to other means. It is of use also in preventing local *perspirations*, and particularly fetid discharges from the armpits and feet.

In chronic mucous discharges tannic acid is often sufficient to arrest the morbid secretion. Injections of it have been used in *gleet*, but they are usually more efficient in the treatment of *leucorrhœa*. They have been successfully employed by Gibert,¹ and Beequerel says that a strong solution of tannin is the best means of treatment. *Prolapsus uteri* has been cured in several cases by means of a tampon soaked with a saturated solution of tannin, and renewed daily for a period of four or five weeks. The practice is said to have been first recommended by Dr. B. F. Barker, of New York; and Dr. C. A. Budd, who has employed it, states that many cases of prolapsus, in various degrees, have resulted, without a single exception, in a perfect and complete restoration.² Other cases, showing more or less success with this method, have been published by Dr. G. A. Kunkler, of Madison, Ind.³

Mr. Haynes Walton has reported a case of large *vascular tumor* of the orbit cured after injection of a solution of tannic acid. The contents of the tumor were coagulated, and were gradually discharged by ulceration and suppuration, and all trace of it finally disappeared.⁴

ADMINISTRATION.—Internally, tannic acid may be given in the dose of two or more grains, in pilular form or in solution. The latter form should be preferred in cases of hemorrhage, and the dose may be increased to ten or more grains. Water sweetened with some palatable syrup is the most proper vehicle. Externally it may be applied to a

¹ Abeille Méd., ii. 182.

³ N. Am. Med.-Chir. Rev., i. 927.

² Med. Exam., March, 1856, p. 190.

⁴ Times and Gaz., Feb. 1858, p. 149.

bleeding or suppurating surface in fine powder, or in a saturated solution, or in an ointment. As a simple astringent wash, from three to ten grains may be dissolved in an ounce of water. An ointment may be used, containing from ten to forty grains to the ounce of lard. The tannin should be first reduced to a paste with water, and then incorporated with the excipient.

ACIDUM GALLICUM.—GALLIC ACID.

DESCRIPTION.—Gallic acid is rarely found as a natural product, and not at all in those substances which abound most in tannic acid. But it may be obtained by depriving this latter of a portion of its carbonic acid. It is usually prepared by exposing a paste made with powdered galls and water for a month to the action of the air, and after expression, boiling the residue with distilled water, and filtering through animal charcoal. On cooling, the liquor deposits gallic acid in a crystalline form. Prepared in this manner, or by the action of sulphuric acid upon galls, gallic acid is in delicate, silky, acicular or rhomboidal crystals, colorless and transparent when pure, and slightly acid and styptic to the taste. It is soluble in one hundred parts of cold and three parts of boiling water, is very soluble in alcohol and but slightly so in ether, and does not cause precipitates in solutions of albumen or gelatin, or of salts of the organic alkalis. With solutions of the salts of the sesquioxide of iron it gives a dark blue color, and a white precipitate with lime and barytes.

ACTION AND USES.—As it has been already stated (vid. *Tannic Acid*), gallic acid manifests a very slight astringency when tasted, or when applied to external bleeding or secreting surfaces, but when absorbed into the system it unquestionably controls morbid discharges. Whether it does so by a temporary conversion into tannic acid, or by some unexplained quality of its own, cannot now be determined; but, as its possession of this power is undeniable, we may reasonably infer that in the treatment of hemorrhages, &c., inaccessible to direct applications, we shall accomplish more with a given dose of gallic than of tannic acid.

It is almost exclusively in the various forms of hemorrhage that gallic acid has been used. One of the first to employ it was Dr. Simpson, who stated, in 1843, that he had prescribed it in *menorrhagia* with the most successful results. Some of the cases which completely yielded under its use were of an old standing and aggravated description. He gave it during the inter-menstrual periods, as well as during

the discharge, in doses of from ten to twenty grains a day, made into pills. It had no constipating effects upon the bowels.¹ Dr. Stevenson, also, of Edinburgh,² and Dr. Neale, of London,³ found it useful in this affection; and Drs. Ballard and Garrod state that in the treatment of menorrhagia, no astringent which they have employed will bear any comparison with gallic acid, either for the rapidity with which the cure is effected, or for the permanency of the result.⁴

In *hæmoptysis* this medicine has been found very efficient by Drs. Neale, Christison,⁵ Homberger,⁶ Hart,⁷ and others. Dr. Hart used it with success in a very obstinate case of this affection, when other remedies entirely failed.

Hæmaturia is, perhaps, the form of internal hemorrhage in which the action of gallic acid has been most favorable. Christison has repeatedly seen it yield to this remedy, and to his testimony, Neale, Stevenson, and Homberger,⁸ add their own. These reports appear to be confirmed by others which assert its utility in *albuminuria*. It is not to be expected that gallic acid can effect a cure of Bright's disease of the kidney, but it may even in that disorganized condition of the part, diminish the amount of albumen secreted, just as the muriated tincture of iron is known to do. In those cases of albuminuria, however, which depend upon temporary causes, as cold, the influence of scarlatina, perhaps conjoined with cold, &c., the urine may be restored to its normal condition, and tannic acid is one means by which this restoration may be accomplished, if the treatment usually adopted during the acute stage of the affection shall have failed of a cure. In 1849, Mr. Sampson published several cases of what were probably Bright's disease, and which were improved in a remarkable manner on the administration of gallic acid, the sp. gravity of the urine changing, under its use, from 1.008 or 1.010, to 1.015 or 1.019.⁹ These statements were, to a certain extent, confirmed by Mr. Lyell,¹⁰ who adds that in cases where the remedy is likely to do good, its beneficial operation becomes apparent within a few days.

Several cases of *purpura hæmorrhagica*, treated with gallic acid by Mr. Grantham, gave incontestable proofs of its efficacy. It was prescribed in five-grain doses every three hours.¹¹ In *epistaxis* during

¹ Month. Jour. of Med. Sci., iii. 661.

² BRAITHWAITE'S Retros. (Am. ed.), viii. 65.

³ Times and Gazette, May, 1855, p. 458.

⁴ WARING'S Manual, p. 226.

⁵ Dispensatory (Am. ed.), p. 967.

⁶ Brit. and For. Med.-Chir. Rev., July, 1850, p. 277.

⁷ Boston. Journ., Feb. 1856, p. 17.

⁸ Jahresbericht, &c., 1848, iv. 159.

⁹ Lancet (Am. ed.), Apr. 1850, p. 330.

¹⁰ Ibid., p. 353.

¹¹ RANKING'S Abstract (Am. ed.), xviii. 31.

typhoid fever, in *hæmatemesis*, even when depending upon organic causes, and in *intestinal* hemorrhage, cases might be cited to show the power of the medicine over the exhalation of blood. It must not, however, be expected to prove uniformly successful, for the pathological conditions accompanying hemorrhage, are too various to be controlled in all cases by the same means. In the present instance, therefore, we need not be surprised to find that Dr. Gairdner has employed the medicine in nearly all of the diseases mentioned, and with but little effect, and that the experience of Drs. Duncan, and Wood, of Edinburgh, does not differ from his own.¹

Dr. Bayes has proposed gallic acid as a remedy for *pyrosis*, and refers to five cases in which its efficacy was equally prompt and permanent.² As this affection is merely a symptom of different disorders of the stomach, the medicine cannot be expected to be equally successful in all of the cases in which it occurs.

Gallic acid has also been recommended as a remedy for the *night-sweats* of phthisis and other wasting diseases.

ADMINISTRATION.—The dose of gallic acid is from five to twenty grains, which may be repeated three times a day or oftener, according to the nature of the case. It may be given in substance in the pilular form, or in powder, but its absorption from the stomach is probably most rapid when it is administered in solution.

CATECHU.—CATECHU.

DESCRIPTION.—Catechu is the extract of the wood of *Acacia catechu*, a native of the jungles and low hills of many parts of India. It is a tree of from 15 to 30 feet high, with thorns on the branches, bipinnate leaves, numerous white flowers in spikes, followed by a thin, flat seed-pod or legume. The inner wood is very hard and heavy and of a dark-red or brownish color, and from this wood, cut into small pieces, the medicinal catechu is extracted by boiling.

Catechu comes in masses of a more or less square or roundish shape, and generally of a rusty or dark-brown color externally, but sometimes lighter internally. It is inodorous, but its taste is bitter and astringent, with, at the same time, a certain mawkish sweetness. It is brittle, and has a resinous shining fracture. It is readily soluble in water, especially in hot water, and reddens a solution of litmus. According to Davy's analysis, 100 parts of Bombay catechu

¹ Edinb. Month. Journ., Apr. 1855, p. 353. ² RANKING'S Abstract (Am. ed.), xix. 83.

contain tannic acid 54.5, peculiar extractive 34, mucilage 6.5, insoluble matter 5. The extractive here mentioned is represented in great part by *catechuic acid*, discovered by Nees von Esenbeck, jr. The tannic acid of catechu is very soluble in water and alcohol, but very slightly so in ether. The solution of catechu yields a precipitate with the salts of alumina, the acetate of lead, and the salts of the sesquioxide of iron.

HISTORY.—The term catechu is derived from the Hindostanee word *catchu*, signifying the sap of a tree, and the words *kutt*, *cutch*, *kassu*, are different forms of the same name. It was formerly supposed to be an earthy substance derived from Japan, and was known as *Terra Japonica*. But as early as 1714, Lemery pronounced it an inspissated juice, and not an earth.¹ The first correct account of its origin was furnished by Mr. Kerr, a surgeon of Bengal, in 1773.² Its medicinal qualities were first described, in 1601, by Garzia del Huerto, physician to the Viceroy of Goa, who stated it to be an efficient remedy for spongy gums, a drying and astringent medicine, useful also in alvine fluxes, and in removing pains in the eyes. According to Lemery, it is adapted to strengthening the brain, the lungs, and the stomach; suitable for catarrhs and for hoarseness; to purify foul breath, and to cure dysenteries and diarrhœas. In Mr. Kerr's original account of it, he states that the natives of India regard it as a very powerful cooling (sedative?) medicine, and as an anaphrodisiac when too profusely used.

ACTION AND USES.—Catechu appears to be less astringent than tannin, but is more so than kino, and probably is less gentle in its operation than this latter upon the bowels. Its virtues are thus enumerated by Alston: "It is astringent, incrassating, and antiseptic; yea, and antacid also; called pectoral and stomachic; and commended internally for fluxes, hemorrhages, the lientery, incontinentia urinæ, dysentery, vomitings, diabetes, fluor albus; in coughs, hoarseness, catarrhs, &c., and externally for spongy gums, loose teeth, sore mouths, &c."

For all these purposes, and in all of these affections, catechu continues to be more or less frequently employed. Its most common use is as an addition to the chalk mixture in *diarrhœa* when this affection is independent of active inflammation of the bowels, as indicated by the absence of fever depending upon the bowel complaint. It may also be used to check *hemorrhage* from the bowels produced by ulceration, or by non-inflammatory exhalation, but not in the acute stages of dysentery. MM. Trousseau and Pidoux state that when administered

¹ *Traité Universel*, 2ème éd., p. 198.

² *Med. Obs. and Inquir.*, v. 148.

by them to consumptive patients in the dose of from fifteen to ninety grains a day, it always diminished the cough, expectoration, and fever materially, the diarrhoea less uniformly, and the perspiration but very little.¹ Uterine hemorrhage has been successfully treated by this medicine, but it is not of such efficacy as to be preferred before acetate of lead or gallic acid. Indeed, it is as a local styptic astringent that its merits are most conspicuous, as in the case of gastro-intestinal discharges already mentioned, but still more so when it is applied directly to the exhaling surface, as in *salivation*, *epistaxis*, and in bleeding from the gums or fauces, and from hæmorrhoidal or vaginal sores. It forms a most valuable ingredient of lozenges to be held in the mouth, in cases of laryngeal irritation produced by slight disorder of the mucous folds surrounding the opening of the glottis, or by a relaxed and elongated uvula, or a flaccid state of the pharyngeal mucous membrane generally. Such lozenges are sometimes made with aromatic ingredients, such as cascarilla, amber, orris, mint, &c., for the use of persons troubled with fetid breath, and for those who smoke or chew tobacco, and are likewise recommended for public speakers to prevent hoarseness. Catechu is also useful when associated with charcoal in the preparation of dentifrices. Gargles containing it are of use in *sorethroat*, without tendency to suppuration.

Mr. Farr has represented the tincture of catechu as superior to any other application for *sore nipples*, when applied twice a day with a camel-hair pencil.² But if it is used during the inflammatory stage, particularly if there is a febrile state of system, it will do more harm than good. Emollient applications must first be employed, such as the following liniment: *R*.—Biborate of soda, gr. x; hot water, ʒj; oil of almonds, ʒvij.—*M*. It is probable that if the tincture or a solution of catechu were applied during the last weeks of pregnancy, it would prevent the nipples from becoming sore. Mr. James Kerr states that an ointment of great repute in India, is composed of catechu four ounces, sulphate of copper four drachms, alum nine drachms, white resin four ounces. These substances are reduced to a fine powder, and mixed with olive oil ten ounces, and water sufficient to bring the mass to the proper consistence of an ointment. It is used "in every sore, from a fresh wound to a venereal ulcer."³

ADMINISTRATION.—The dose of powdered catechu is from ten grains to thirty, and of the tincture (*TINCTURA CATECHU*) from half a fluidrachm to three fluidrachms.

¹ *Thérapeutique*, 5ème éd., i. 120. ² *Lancet*, April, 1842, p. 154, and July, p. 523.

³ *Loc. sup. cit.*

CHIMAPHILA, vid. *Diuretics*.

CREASOTUM, vid. *Stimulants*.

GALLA.—GALLS.

DESCRIPTION.—Galls are morbid excrescences upon *Quercus infectoria*, a shrub which abounds in Asia Minor and Central Asia. They are produced upon the tender branches by the puncture of *cynips gallæ tinctoriæ*. The female of the insect deposits her egg in the wound which she has made, and around it the gall is gradually developed, and serves for food to the larva after it is hatched, and until it makes its escape through an aperture which it bores for itself. Galls are of about the size of a filbert, rounded and tuberculated upon the surface, heavy, and so hard that they cannot be broken without the aid of a hammer. When collected before the full development and escape of the insect, they are of a bluish or blackish-green color; but after the insect has escaped, they are of lighter color, less heavy, and also less astringent. The former are, therefore, the only ones that should be used for medicinal purposes.

According to the analysis of Guibourt, galls contain 65 per cent. of tannic acid, and only two per cent. of gallic acid, together with small proportions of bitter extractive matter and gum.

HISTORY.—Galls were used for medicinal purposes by the ancients. In the Hippocratic writings it is stated that they were administered internally for uterine hemorrhage, and used locally in prolapsus uteri, in an ointment to cure foul ulcers, with wine as an application to the anus after the excision of hæmorrhoids, and also with myrrh and alum upon enlarged veins.¹ A similar account is given by Dioscorides, Galen, and the Arabian writers, who also describe the mode of production of these bodies.

ACTION AND USES.—The principal quality of galls is astringency, depending upon the tannic acid which they contain, but the bitter extractive matter probably modifies in some degree their astringency by exerting a tonic action. On this account, the infusion of galls, their watery extract, and a syrup prepared with the tincture of galls, or with an infusion of powdered galls in brandy, have been found very efficacious in cases of chronic diarrhœa connected with debility and impairment of the system. A syrup of galls with iron is recommended by MM. Trousseau and Pidoux, under similar circumstances.

¹ DIERBACH, Die Arzneimittel des Hippokrates, p. 98.

Galls have been also proposed as an antidote to poisoning by tartar emetic and the vegetable alkaloids, on the ground of their forming insoluble compounds with these substances. If they are efficacious in such cases, which, however, is not sufficiently proven, it is quite as probably owing to their astringency, which renders the mucous membrane of the stomach and bowels inapt for absorption, as for the chemical reason which has been stated.

As an external application, the infusion of galls is often used to give firmness to the relaxed mucous membrane of the mouth and fauces, the vagina, and the rectum, but it is a less efficient and a less elegant preparation than a solution of tannic acid. The ointment of galls is frequently applied to hæmorrhoids, and in other relaxed or irritated conditions of the anus and rectum. Under such circumstances, equal parts of ointment of galls (*Unguentum Gallæ*), Goulard's cerate, and stramonium ointment, form a very efficient combination.

An infusion, made with from half an ounce to an ounce of coarsely powdered galls in a pint of boiling water, may be given in the dose of a wineglassful three or four times a day.

GERANIUM.—CRANESBILL.

DESCRIPTION.—Cranesbill is the root or rhizoma of *Geranium maculatum*, an indigenous herbaceous plant, growing throughout the United States, and generally in moist, low situations. The stem is erect, one or two feet in height, with large petiolate, lobed, and serrated leaves, which, like the stem, are of a pale green color. The flowers are large and usually of a purple color. The rhizome is perennial, horizontal, and fleshy, and when dried, is of a dark brown color externally, and of a pale flesh color within. It is inodorous, and has a very astringent taste, without bitterness. It yields its properties to water and to alcohol. They appear to depend upon tannic and gallic acids.

ACTION AND USES.—Cranesbill is said to have been used by the aborigines as a medicine. Eberle pronounces it the most agreeable astringent that we possess, on account of its not being associated with bitterness or any other unpleasant taste. On this account, it has been much used as a domestic remedy, and by physicians in the *bowel complaints* of children, and a decoction of it in milk is frequently administered in *cholera infantum*. In *aphthous affections* and ulcerations of the mouth and throat, it may be prescribed as a wash or gargle, and in a relaxed state of the mucous membrane of the same parts. It has

also been recommended as very efficacious in restraining internal *hemorrhages*, and is said to be efficient as an injection in *gleet* and *leucorrhœa*.

ADMINISTRATION.—This medicine may be given in substance in the dose of from twenty to forty grains; or in a decoction made by boiling an ounce of the root in a pint and a half of water to a pint, of which the dose is one or two fluidounces. To infants, a decoction made with an ounce of the root in a pint of milk, may be given in teaspoonful doses, repeated according to the susceptibility of the stomach, or the urgency of the case.

GRANATI FRUCTÛS CORTEX.—*Pomegranate Rind*.

GRANATI RADICIS CORTEX.—*Bark of Pomegranate Root*.

Vide *Anthelmintics*.

HÆMATOXYLON.—LOGWOOD.

DESCRIPTION.—This is the heart-wood of *Hæmatoxylon Campechianum*, a native tree of Campeachy, but naturalized in many of the West India Islands. The tree is of medium size, has a contorted trunk, and is covered with a rough bark. The branches are crooked, and beset with sharp thorns. Logwood, so called from its being imported in logs or long billets, is of a dark reddish-brown color, very hard and compact, and susceptible of a high polish. It has rather an agreeable odor, and a sweetish and somewhat astringent taste. In the shops it is found cut into chips or rasped into a coarse powder. It yields its virtues to alcohol and water, and imparts to these liquids a deep purplish-red color, on which account it is extensively used in the arts as a dye.

ACTION AND USES.—Logwood is, according to Alston, “subastringent, and probably also antiseptic and diuretic.” Lemery calls it “astringent and stomachic,” and various writers agree that it possesses tonic as well as merely astringent properties. As was long ago noticed by Lewis¹ and by Percival,² it darkens the feces, and sometimes tinges the urine of a purplish or dark color, and gives it an astringent taste. This color has sometimes erroneously been attributed to blood in the urine. It has not a constipating effect in the same degree as

¹ Mat. Med., 4th ed., ii. 61.

² Essays, 4th ed., ii. 386.

the purer astringents, and hence is inferior to them whenever a flux is to be diminished by a direct action upon the secreting part. In the last edition of Percira's *Materia Medica* two cases are referred to in which the arrest of chronic diarrhœa by means of logwood was followed by phlebitis of the femoral vein.¹ It may be suspected that in these cases the intestine was ulcerated, and that the phlebitis which followed the administration of logwood would equally have followed that of any other astringent which suddenly arrested the secretion from the diseased surface.

The general uses of logwood are the same as those of other astringent medicines, to control diarrhœas and other fluxes, to repress hemorrhages and excessive sweats, and to cleanse foul ulcers; but it is less efficacious than tannin itself, and other articles belonging to the same class. Its comparative mildness is thought to give it a preference over these latter in the treatment of infantile diarrhœa.

ADMINISTRATION.—The decoction and the extract of logwood are officinal. The *Decoction* (DECOCTUM HÆMATOXYLI) is prepared with an ounce of rasped logwood and two pints of water boiled down to a pint. A little bruised cinnamon may be added with advantage at the end of the boiling. The dose for an adult is two fluidounces, and for a child of two or three years old two or three fluidrachms. Of the *Extract* (EXTRACTUM HÆMATOXYLI) the dose is from ten to thirty grains, given in solution.

KINO.—KINO.

DESCRIPTION AND HISTORY.—“Kino is the inspissated juice of *Pterocarpus Marsupium* and of other plants.” The first account published of this substance was in 1757, by Dr. John Fothergill, who proposed to name it *Gummi Rubrum astringens Gambiense*, on account of its having been brought from the river Gambia.² A few years ago, Dr. W. F. Daniell, being stationed on the Gambia, availed himself of the opportunity afforded him of investigating the botanical source of African kino, and concluded that it is derived from *Pterocarpus erinaceus*.³ In India a variety is used which is imported from New Holland,⁴ and is said to be the inspissated juice of *Eucalyptus resinifera*, while that which is imported into England from Bombay and Tellicherry, and is known as *East Indian* or *Amboyna kino* (*Pereira*), was not ascertained

¹ 4th ed., vol. ii., pt. ii., p. 347.

² Med. Obs. and Inq., 3d ed., i. 358.

³ Am. Journ. of the Med. Sci., July, 1855, p. 185.

⁴ AINSLIE, Mat. Ind., i. 185.

to be the product of any native tree until the investigations of Dr. Royle determined it to be the inspissated juice of *Pterocarpus marsupium*. The same writer has also rendered it probable that the name kino is of Indian origin, for the natives of Hindostan apply the term *kuenee* or *kīni* to a similar exudation from the bark of *Butea frondosa*. There are two American varieties of kino, the one known as *West India* or *Jamaica kino*, the product of *Coccoloba uvifera*, and the other called *South American* or *Caracas kino*, whose botanical source has not yet been discovered.

There does not appear to be any essential difference among these different varieties of kino. They all are of a reddish-brown color, thin portions are of a garnet-red by transmitted light, and they are readily broken into shining angular fragments. East India kino comes in such fragments, but the West India and South American varieties are in large masses. Kino is inodorous, and has a bitterish, highly astringent, and somewhat sweetish taste, and dissolves imperfectly but becomes soft and adhesive in the mouth. It is partially soluble, when recent, in hot water—which, however, becomes turbid on cooling—and also in alcohol, and gives to its solution a blood-red color. According to Vauquelin's analysis, the constituents of East Indian kino are: *tannin* and *peculiar extractive* 75, *red gum* 24, insoluble matter 1. More recent analyses have determined its constituents to be kinoic and tannic acids, pectin, ulmic acid, and inorganic salts with an excess of earthy bases. With the sesquisalts of iron it furnishes a dark-green precipitate.

ACTION AND USES.—It was early noticed as a peculiarity distinguishing kino from other astringents, that it is possessed of "a gummy nature" (*Lewis*), or as others expressed it, "an aromatic quality" (*A. Fothergill*), and on this account it was from the beginning much employed in recent diarrhoeas, after the use of evacuant remedies. Even in France, during the reign of the "physiological doctrine," its utility in these cases was recognized. Bally relates that when there was violent pain and even tenderness on pressure, with fever, twelve or fourteen grains of kino, given three, four, or five days, successively, proved sufficient to effect a cure.¹ Sandras, soon afterwards, insisted upon the same fact. Kino, he remarks, is not an irritant whose local action is to be dreaded, but it is a sufficiently powerful astringent to promptly arrest diarrhoea. Going even further, he says, with reference to chronic diarrhoea, although the patient should present symptoms of chronic irritation of the gastro-intestinal mucous

¹ Lond. Med. Gaz. (1830), v. 700.

membrane, and his strength forbids a resort to antiphlogistic treatment, even if the stools are composed of a bloody liquid, kino, supported by an appropriate regimen, will often repress these symptoms, and restore the health which appeared to be irretrievably lost. He also found it a peculiarly appropriate remedy in the declining stages of enteritis, but not when diarrhœa was dependent upon ulcerations of the intestine, as in tuberculous phthisis.¹

In gastric disorders accompanied with excessive mucous secretion in the stomach, it has been thought to possess peculiar advantages. Long since it was used by Pemberton as a principal remedy for the symptom known as *waterbrash*, in its incipient stages. He associated it with a small proportion of opium. "I prefer the kino," he remarks, "to any other astringent, because, unless there is a diarrhœa, it appears to have no tendency to confine the bowels."² In the same affection Dr. Watson recommends a similar medicine, the *pulvis kino compositus* (*Lond.*). It, however, contains cinnamon, which is an objectionable ingredient under the circumstances.³ Dr. Chambers also says that kino is certainly of great use in cases where gastric flux is complicated with pyrosis, and he makes the same remark as Pemberton, that in these cases, even when joined to opium, it does not produce constipation; sometimes, indeed, it relieves that symptom, by removing the general state of irritability and discomfort, and perhaps by checking the secretion of mucus. In cases attended with much gastric pain, he associates kino and bismuth.⁴ Dr. James Turnbull also mentions kino as one of the best remedies for these affections.⁵

Another disease in which this medicine has been found serviceable, is *diabetes*, and not only the insipid, but also the saccharine form. Pemberton recommended it; Sandras, in the paper already referred to, relates a case of saccharine diabetes which it cured, and Prout mentions it among the astringents which are occasionally of service.⁶ Dr. Watson found that in the last stages of *phthisis* the compound powder of kino is an admirable medicine in controlling both the perspiration and the diarrhœa, and in calming the cough.⁷ Kino was originally used with advantage in *menorrhagia*, but more efficacious remedies have supplanted it; and in some cases of intestinal and gastric hemorrhage it has been found efficient when given in substance and in large doses.

¹ Bull. de Thérap. (1834), vii. 189. ² Dis. of the Abdominal Viscera, 4th ed., p. 111.

³ Lectures, 3d Am. ed., p. 780.

⁴ Digestion and its Derangements, p. 364 and p. 343.

⁵ Disorders of the Stomach, p. 116.

⁶ Stomach and Renal Diseases, 4th ed., p. 51.

⁷ Op. cit., p. 651.

As a local astringent, kino has been used to contract the granulations of flabby *ulcers*, and to cleanse and constrict those of a foul or scorbutic character. A solution of it in red wine is preferable in such cases. A watery solution may also be used as an injection in *leucorrhœa*, and in *dysentery*; and finely-powdered kino may be applied as a *hæmostatic* to bleeding surfaces. But in all of these cases it is probably inferior to tannin.

ADMINISTRATION.—Kino may be given in substance, in *pill*, or *powder*, and in the dose of from ten to thirty grains. Two drachms of kino dissolved in eight fluidounces of boiling water, and strained when cool, form an *infusion* which may be prescribed in the dose of one or two tablespoonfuls. The infusion prepared in this manner may serve as a convenient vehicle for chalk in the treatment of diarrhœa. When the tincture is used as an ingredient of the chalk mixture, the gummy matter of the kino is apt to coagulate.

KRAMERIA.—RHATANY.

DESCRIPTION.—Krameria is the root of *Krameria triandra*, a native plant of Peru, with a long, dark, procumbent stem, bearing numerous spreading branches and bright-red flowers. The young leaves are pubescent and shining. The roots are long and spreading, and of a blackish red color. As found in commerce, rhatany root consists of cylindrical pieces from one to several feet in length, and varying from an eighth of an inch to an inch in thickness; or of numerous radicles attached to a short, thick root-stock. It is composed of a cortical and a central or woody portion. In the former the virtues of the root chiefly reside, and it has a very astringent and somewhat bitter and sweetish taste. Cold and boiling water extract its virtues, but alcohol more perfectly. According to Gmelin, rhatany contains 38.3 per cent. of tannin, with sweet matter and mucilage, together 15 per cent.; and Peschier has discovered in it a peculiar acid which he calls *Krameric*. An infusion of rhatany is precipitated by gelatin, and gives a brownish-gray precipitate with sesquichloride of iron.

HISTORY.—Rhatany was discovered in Peru by Ruiz in 1779. Five years afterwards he found that the root was used by the ladies of Huanuco to whiten their teeth and render the gums firm and of a healthy color, and suspecting from this circumstance that it must possess astringent qualities he administered it in cases of hemorrhage from the stomach and womb. Some of the root was carried to Spain, and found efficacious in similar affections, and in 1796 Ruiz published

an account of its virtues in the *Memoirs of the Academy of Madrid*. It was not until 1816 that the virtues of rhatany became generally known, when Hurtado, a Spanish refugee in Paris, presented to the *Société d'Emulation* of that city, a paper in which the history of the drug was narrated, and numerous cases observed by Ginesta, Bonafos, and himself, were related to demonstrate its virtues as a cure for passive hemorrhages.¹ Pereira states that it was introduced into England in 1808, and that Ruiz's dissertation on it appeared in an English dress in 1813, but no mention of the drug is contained in the second edition of Dr. John Murray's *System of Materia Medica*, published in 1813. In this country it was not noticed in the edition of Chapman's *Therapeutics*, published in 1831.

ACTION AND USES.—The operation of rhatany in the system does not differ materially from that of kino and catechu, but perhaps it more closely resembles the former than the latter in its effects. Like these medicines, it is somewhat tonic in small doses, in larger ones powerfully astringent, and in the latter case having a tendency to produce gastric uneasiness and oppression.

As it has been stated above, the original application of krameria in medicine was in cases of passive *hemorrhage*; in *uterine* hemorrhage after labor, *menorrhagia*, *hæmaturia*, *hæmoptysis*, *hæmatemesis*, and *epistaxis* it was represented as having proved very efficacious. In these affections its virtues have been since confirmed by Kopp, Sachs, Sundelin, and others. Dr. Watson refers to a case of *hæmaturia* in which a scruple of the extract of rhatany mixed with water was given three times a day. The ordinary routine of treatment had before been tried without benefit, but after the first dose of rhatany the hemorrhage ceased.² Rilliet and Barthéz relate two cases of intestinal and gastric hemorrhage in new-born twin infants, in which enemata of a decoction of rhatany, and compresses soaked with the same and applied to the abdomen, did not appear to be of any service, although the children recovered.³ In that form of *menorrhagia* which females describe by the phrase "being almost constantly unwell," and where the aggregate quantity of the discharge may not greatly exceed the common monthly amount, Dewees frequently succeeded in effecting a cure by means of two drachm doses of the tincture of rhatany three or four times a day, or six grains of the extract with one or two grains of rhubarb, repeated at similar intervals.⁴ The medicine had before been successfully used

¹ Journal de Médecine (de Leroux), Nov. 1816, xxxvii. 212.

² Lectures, 3d Am. ed., p. 903.

³ Maladies des Enfants, 2ème éd., ii. 301.

⁴ Diseases of Females, 3d ed., p. 153.

by Gardien and Ruitz. Dr. Levrat, of Lyons, made use of an extract prepared with alcohol and sulphuric acid, which is represented as possessing a highly constrictive and somewhat irritant action upon the stomach, and as peculiarly efficient in all forms of passive hemorrhage.¹

The tonic property which rhatany appears to possess, as well as astringency, has caused it to be prescribed in cases of debility and exhaustion, from whatever cause. Tournel attributes to it the prevention of *miscarriage* in delicate women who had previously been subject to this accident; incontinence of urine, a scorbutic state of the mouth, fever from atony, and atonic dyspepsia, are all of them said to have been successfully treated with this remedy.²

The *local* applications of rhatany are more general, if not more valuable, than its internal uses. One of the most important of these applications is in the treatment of *fissure of the anus*. As M. Trousseau remarks,³ the ordinary treatment formerly consisted either in applying relaxing ointments, which were intended to overcome the constriction, or in preventing the constriction by dividing the sphincter muscle of the anus with the knife. But Bretonneau, observing in certain cases that the apprehension of pain prevented those who suffered with this disease from voiding the bowels, and that consequently the rectum became distended more and more with feces, the mass to be discharged more voluminous, and therefore the pain in voiding it greater, considered that by restoring the rectum to its normal size and power he should promote the cure of the disease. He accordingly prescribed enemata made with a watery solution of rhatany and some of the tincture, and succeeded perfectly in curing this painful affection. But as further observation showed that in many cases of fissure of the anus no constipation existed, and yet that rhatany effected a cure, it was evident that the preceding view of its operation could not be exclusively accepted. It must be presumed, indeed, that the astringent action of the medicine diminishes the afflux of blood to the part, and also directly as well as indirectly promotes the cicatrization of the fissures by rendering the rectum and the anus less distensible by the efforts of defecation. The following mode of using rhatany in this disease is recommended by M. Trousseau. An emollient enema is administered every morning to empty the bowel, and half an hour afterwards a solution of a drachm or a drachm and a half of rhatany in five ounces of water, with the addition of a drachm of tincture of rhatany, is thrown into the bowel. A similar enema should be taken

¹ Bull. de Thérap., xxiii. 319. ² MÉRAT AND DE LENS, Dict. de Mat. Méd., iii. 727.
³ Thérapeutique, 5ème éd., i. 124.

at night, and on both occasions it should be retained only for a moment. This remedy, with some modifications in the mode of applying it, rendered necessary by the peculiarities of individual cases, is nearly always successful. If the bowels, as is usually the case, are confined, they must be kept open during the treatment by gentle laxatives and appropriate food. M. Trousseau advises, as the best laxative under the circumstances, from one-fifth of a grain to one grain of the powdered root of belladonna. The patient for whom this method is prescribed should be warned that his sufferings will, for the first two or three days, be aggravated by the more frequent necessity of going to stool; but this annoyance is usually temporary, and is followed by inexpressible relief. Moreover, the frequency of using the injections must be regulated by the ability of the patient to bear their repetition, and should gradually be diminished as the disease declines. Enemata of rhatany are also beneficial in the treatment of *dysentery*. In small quantity they are sometimes recommended to relieve tenesmus in this disease; but we have employed enemata of a pint of the infusion of rhatany with marked advantage, not only in alleviating the tenesmus, but in controlling the disease itself.

Marchal, Blache,¹ and Trousseau have also applied the same solution to the treatment of *sore nipples*. The last-named physician prescribes, in addition, a thin paste made with the extract and white of egg, which he allows to remain in the fissures of the nipple, when they exist, taking care to wash the part each time before the child nurses, and to allow it to nurse as little as possible.

Dr. Detmold, of Hanover, states that he has never failed to cure ordinary *ozæna*, or the chronic fetid and purulent discharge from the nasal passages, by means of an injection composed of one or two drachms of chloride of lime rubbed up in a glass mortar with thirteen ounces of decoction of rhatany root, and strained off after standing for half an hour.² It should be injected three or four times a day by means of a syringe, having a long canula or a piece of catheter attached. The defect of this, and all similar remedies, is, that when the disease occupies, as it often does, the frontal sinus, it is entirely beyond the reach of an injection.

Solution of the extract of rhatany has also been recommended as a collyrium in blennorrhœal ophthalmia, as a wash for mercurial and other forms of stomatitis, as a gargle in cases of relaxation of the uvula and pharyngeal mucous membrane, as an injection in blennorrhœa and leucorrhœa, and as an application to profusely suppurating and painful portions of the skin.

¹ Abeille Méd., i. 255.

² Brit. and For. Med. Rev., xii. 549.

ADMINISTRATION.—The dose of *powdered* rhatany is stated at from twenty to forty grains, but this form of the medicine is seldom or never employed. An *infusion*, made with one ounce of krameria to a pint of boiling water, macerated for four hours and strained, may be given in doses of two fluidounces. The *extract* (EXTRACTUM KRAMERLÆ) may be administered in doses of from ten to twenty grains; in powder when it is intended to act upon the stomach, in solution when it is meant to be absorbed. The *tincture* and also the *syrup* of rhatany are officinal. The dose of the former is a fluidrachm, and of the latter half a fluidounce. For infants at the breast, the dose of the syrup is from twenty minims to a fluidrachm. It is often used in summer complaint, and kindred disorders, when there is no marked evidence of inflammatory action.

QUERCUS ALBA.—WHITE OAK BARK.

QUERCUS TINCTORIA.—*Black Oak Bark.*

DESCRIPTION.—The bark of the oak, a tree of which there are very numerous species, and which abounds in the temperate portions of the northern hemisphere, is everywhere essentially the same, but of the two officinal species, *Q. alba* is remarkable for astringency, and *Q. tinctoria* for possessing tonic qualities.

Quercus alba, or American white oak, furnishes a bark which, when deprived of its epidermis, "is of a light-brown color, of a coarse, fibrous texture, and is not easily pulverized. It has a feeble odor, and a rough, astringent, and bitterish taste." It yields its active properties, which depend chiefly upon tannin and gallic acid, to water and alcohol.

Quercus tinctoria is so called because it yields a valuable yellow color, used as a dye for wool and silk. This coloring matter causes it, when chewed, to stain the saliva yellow. Black oak bark, or *quercitron*, as it is called in commerce, contains, besides tannic and gallic acids, a peculiar principle which combines with salifiable bases, and is called *quercitrin* or *quercitric acid*.

HISTORY.—Dioscorides says that all oaks are astringent, and refers to the inner bark as the principal seat of this property. The decoction of oak bark is useful, he remarks, in hæmoptysis and dysentery, and pessaries are made of it when bruised to restrain uterine hemorrhage. Bruised oak leaves, he adds, are used to cure inflammations and

fortify relaxed parts.¹ Acorns were recommended in similar cases, but as less powerful; and many of the ancient writers speak of them as being used for food. Pliny gives a very interesting account of the oak tree and its uses.² The Arabians chiefly describe acorns, which they say possess astringency, and that they are used for food, but are very little to be depended upon.

ACTION AND USES.—It is said that the bodies of animals that have had a certain quantity of oak bark mixed with their food for some time before being killed resist putrefaction in an extraordinary manner, and that tan is administered to animals threatened with gangrene after severe injuries. Hence, it has been suggested, although the analogy seems a forced one, that large doses of this substance might possibly be useful in typhoid forms of disease.

Preparations of oak bark have been given internally in various *hemorrhages*, and in *chronic fluxes* of the bowels and bronchia, and even in *intermittent fever*, but they are seldom resorted to when other and more potent or appropriate remedies are at hand. An infusion of roasted acorns has been used in the atonic diarrhoea of children. Barbier was of opinion that the emanations of tanyards counteract the miasm of intermittent fever, and a similar notion has prevailed in regard to tubercular phthisis. Thackrah held this opinion regarding the latter affection, stating that, after careful inquiry at several tanyards, he could not hear of a single example of this formidable disease. He quotes also the statement of Dr. Dods, that he had “not been able to discover one unequivocal instance of death to have taken place in an operative tanner from phthisis, in its tubercular form, in any part of the kingdom.”³ Geoffroy remarked also that the workmen employed in tanneries are rarely attacked with intermittent fever.⁴

Externally, decoctions and fomentations of oak bark have been used for all the purposes to which the other astringents are applied; in prolapsus of the rectum, hæmorrhoids, leucorrhœa, relaxation of the mucous membrane of the fauces, to promote the contraction of the skin over parts which have been unduly stretched, to prevent the formation of bed-sores, to heal flabby and ill-conditioned ulcers, and promote the separation and diminish the smell of gangrenous parts, and, finally, as a general bath, in cases of extreme debility with flaccidity of the tissues.

ADMINISTRATION.—The only preparation of oak bark which is administered internally is the *decoction*, and even that but rarely. It

¹ Mat. Med., lib. i. cap. cxxi.

² Hist. Nat., lib. xvi. cap. i. et seq.

³ Effects of Arts, &c., on Health, &c., p. 61.

⁴ PATISSIER's edit. of Rammazzini, p. 144.

is prepared by boiling an ounce of the bruised bark in a pint and a half of water to a pint. The dose is a wineglassful. A decoction made of double the strength of that just described should be prepared for external use.

ROSA GALLICA.—RED ROSES.

DESCRIPTION.—Two species of rose are recognized in the *United States Pharmacopœia*, *Rosa centifolia* and *Rosa Gallica*. The former, commonly called *hundred-leaved rose*, is chiefly used in the preparation of rose-water. Its petals are somewhat laxative in their action. Red roses are not extensively cultivated for medicinal purposes in this country. They are very abundant in the South of Europe, and particularly in France, whence the name of *R. Gallica*. But they are also extensively cultivated in Germany and Holland. The petals are large, of a velvety appearance, and crimson color, and, when dry, have a grateful fragrance. Their taste is slightly astringent and somewhat bitter. Red roses contain tannic and gallic acids, volatile oil, coloring matter, &c. Their infusion has an acid reaction.

HISTORY.—The earliest mention of roses as a medicine is that made by Homer, of their being used at the time of the Trojan war. Several species are referred to in the Hippocratic writings, and the leaves are stated to be useful in uterine and other hemorrhages, and, when bruised, as an application to inflamed and ulcerated parts.¹ According to Dioscorides, roses are cooling and astringent. He describes a mode of extracting their juice to be used for inflamed eyes, and a preparation of the dried leaves in wine as a sedative and astringent application to these organs, to the ears, gums, anus, &c. He recommends a powder of dried rose-leaves for intertrigo, and says that an infusion of rosebuds confines the bowels and is useful in hæmoptysis.² Several varieties of the rose are mentioned by Arabian writers, as red, white, yellow, and even black. They report Persian roses to be the best, and describe them as of a dark color, powerful fragrance, and having thick-set petals. They assign to them the qualities already enumerated, mention a gargle made with roses boiled in honeyed water, say that they lessen intoxication, repress the venereal appetite, remove warts, heal ulcers and aphthæ, and correct fetor of the breath. Bruised rose-leaves are recommended as an application to inflamed eyes, and confectio of roses as an internal medicine.³

¹ DIERBACH, *Arzneim. des Hippokrates*, p. 80.

² *Mat. Med.*, lib. i. cap. cxii.

³ BEN BAITHAR, ed. Sonthimer, ii. 582.

ACTION AND USES.—Red roses have been used for the same purposes as the other medicines of their class, and even to cure pulmonary consumption. They are seldom prescribed at the present day, except in preparations which serve as excipients to other medicines. Although commonly regarded as astringent (and its unexpanded petals are really so), the full-blown flowers are, like the hundred-leaved species, slightly laxative. An *infusion* of rose-leaves is frequently prescribed with honey (MEL ROSÆ), vinegar, &c., as a gargle, as a vehicle for the administration of sulphuric acid in hemorrhage, &c. The *compound infusion* (INFUSUM ROSÆ COMPOSITUM) forms a useful solvent for the salts of quinia and the sulphate of magnesia, the taste of which it partially conceals. *Confection of roses* (CONFECTIO ROSÆ) is the usual excipient of substances given in the pilular form, and which it is desired should speedily dissolve in the stomach. *Honey of roses* (MEL ROSÆ) forms an excellent detergent application to aphthous and other ulcerations of the mouth and fauces; and *syrup of roses* (SYRUPUS ROSÆ GALLICÆ, *Ed.*) is employed occasionally as a laxative for infants in the dose of two fluidrachms. It may also be used as a coloring and sweetening ingredient of mixtures.

RUBUS VILLOSUS.—BLACKBERRY ROOT.

RUBUS TRIVIALIS.—Dewberry Root.

DESCRIPTION.—These are the roots of two indigenous plants which abound in the middle and southern portions of the United States, and are familiar to every one by their agreeable fruit. The blackberry is a shrub of from three to six or seven feet high, and the dewberry a creeping vine, and both bear compound round or conical berries, which are black when ripe, and consist of pulpy seed-globules, each containing a seed. The root of the former is woody, varying in diameter from an inch to that of a straw, and is covered with a reddish-brown epidermis; while that of the latter is smaller, and is of a dark grayish color. Their virtues reside in their bark, which is very astringent and somewhat bitter, and they may be extracted by boiling water and by diluted alcohol.

ACTION AND USES.—These roots possess astringent and probably tonic virtues, and are much used in the summer complaint and diarrhoea of children as a domestic remedy. Usually a decoction is prepared, in the proportion of an ounce of the root to a pint of water, or sometimes of milk, according to the stage of the disease and the

condition of the patient. Dr. Chapman says that to check the inordinate evacuations which commonly attend the protracted stages of cholera infantum no remedy has ever done so much good in his practice. Some persons have claimed for it antilithic virtues. It may be used for internal hemorrhages in the absence of more efficient medicines.

UVA URSI, vid. *Diuretics*.

Various other vegetable astringents have been used in medicine, such as Monesia, Bistort (*Polygonum bistorta*), Tormetil (*Tormentilla*), Marsh Rosemary (*Statice*), Plantain (*Plantago major*), Agrimony (*Agri-
monia eupatorium*), Alum root (*Heuchera*), Hardhack (*Spiræa tomen-
tosa*), Beech Drop (*Orobanche Virginiana*), Avens (GEUM VIRGINIANUM
ET RIVALE), Persimmon (DIOSPYROS), &c. Indeed, of all the medicinal qualities with which plants are endowed, astringency is possessed by the greatest number. But those which have been described already, with some detail, will probably be found more than sufficient to meet the demands of medical practice.

CLASS III.

IRRITANTS.

As their name imports, irritants are medicines which are intended to irritate the part to which they are applied. They are conveniently divided into two classes, the first of which comprehends *rubefacients*, so called because they redden the integument by quickening its capillary circulation; the second comprises agents which are capable, more or less completely, of disturbing the arrangement of its organic constituents. These are *epispastics* (from *σπᾶω*, I draw), or blistering agents, which cause an elevation of the epidermis, with a secretion of serum beneath it, and *caustics* or *escharotics*, which destroy the organization of the tissues (from *καίω*, I burn, *εσχαρα*, an eschar).

The purposes for which medicines of this class are employed may be described by the terms irritant, counter-irritant, depletory, and escharotic. The first of these titles is generical, but it is also used in a more restricted sense, implying that the irritation produced embraces the entire operation of the medicine, or at least the only one aimed at as a therapeutical object. Counter-irritation includes derivation and revulsion. Of these two latter terms, which were introduced by Galen, derivation implies that an irritation or discharge is produced in one organ for the relief of another in a state of disease. This author describes revulsion as an operation tending to draw away a morbid action from its seat, having a downward direction in affections of the upper part of the body, an outward direction for those of the interior, &c. According to these definitions revulsion is merely a mode of derivation; but as both imply a particular mode of action which is assumed rather than proved, the term counter-irritation, which denotes the fact common to both, without involving any hypothesis, appears to be preferable to either.

Many irritants are to be found among internal remedies of the emetic, purgative, diuretic, and other classes. Sanguineous depletion, and especially local depletion, has also a derivative operation, partly by

means of its irritant action, and partly in virtue of the laws which govern the circulation; but it has also an antiphlogistic influence, which entitles it, as a medicinal agent, to a place among sedative medicines, if it is not to be classed among surgical remedies. But many irritants are true depletives, although the fluid which they evacuate is not blood, but serum or pus, the discharge of which is hardly less operative as a remedial agent than the loss of blood itself.

Mechanism of Medicinal Irritation.—Irritant medicines are chiefly used to modify the vascularity and the nutrition of diseased parts, and especially to control congestion and the other elements of inflammation.

Inflammation is a disordered and exaggerated mode of nutrition. In both processes the same essential elements are concerned. The heat, redness, pain, and swelling, which characterize the former, are simply the normal processes of the latter abnormally augmented and more or less modified in their phenomena by the causes which primarily occasion them, and by the state of the economy in which they occur. By a reference to the mechanism of inflammation, we are enabled to explain, in part at least, the curative action of irritant applications.

Inflammation consists essentially in the afflux of blood to a part, and the reactions which thereupon ensue. There is a stage of the process in which the affluent blood is contained wholly within the bloodvessels, where it stagnates. At this stage the oppressed organ struggles under its unusual load, and often unsuccessfully, unless spurred to extraordinary efforts by some stimulus from without. But under this impulse the accumulated blood is urged along its channels, the distended vessels contract, and the part returns to its normal condition bearing no trace of the violence it has undergone. But in the supposed case, inflammation has not been fully established, it is either of that form which is called erythematous, or it represents the congestive stage of the forms which tend to produce ulterior changes. In these latter effusion succeeds congestion. The liquor sanguinis escaping through the meshes of the bloodvessels floods the adjacent cellular tissue, and there coagulates; to the redness, swelling, and heat of the first or congestive stage, succeed the greater redness, swelling, and heat, and the hardness and pain of the second stage of the process, and it now depends in a great measure upon the use of remedial agents how long the solidified effusion shall remain, and whether the destructive processes of suppuration, ulceration, or gangrene, shall ensue. While the morbid deposit is recent, susceptible of absorption, and still prone to suppurative or other degeneration, the danger consists in an excessive activity of the molecular changes. To moderate these, and

to restrict them within proper limits, the counter-irritant operation of the present class of remedies is invoked; for, under a law of the economy, an artificial inflammation acting at a certain distance from one of spontaneous origin, palliates this latter, and often, at the will of the physician, arrests its progress towards disorganization. Finally, if the exudation, whether strictly inflammatory, or, owing to its close analogy with the products of nutrition, persists in such bulk, form, or position as to render its removal desirable, the class of irritant medicines affords agents which imitate the destructive processes above referred to, and by prolonged suppuration, or, more rapidly, by an escharotic action, reduce them to less troublesome dimensions, or destroy them entirely.

In the preceding remarks the most ordinary type of local inflammation, the phlegmonous, has been chiefly referred to. But inflammation is frequently characterized by extreme pain, by swelling, and by redness, although the effusion of plastic matter may be very slight or absolutely wanting. Such a form of disease is familiarly exhibited in rheumatism, which, even in its most active varieties, does not produce an organizable effusion in any degree proportioned to the amount of pain, heat, and swelling, which it occasions, or one which at any time tends to purulent degeneration. Mobility from place to place is a characteristic symptom of this affection. A step further removed from typical inflammation, we find neuralgic affections presenting the element pain in its purest form, and often in its highest degree, and only exceptionally attended with swelling, heat, or redness. The peculiarities of rheumatic and neuralgic affections depend to some extent, no doubt, upon the fibrous and nervous tissues in which they are seated; yet both of these tissues are liable to changes produced by traumatic causes, which prove that they are susceptible to inflammation with all its ordinary phenomena. We must, therefore, conclude that rheumatism and neuralgia, while embracing inflammatory elements, do not derive from them their characteristic features. They, indeed, throughout the greater part of their course, manifest a facility of translation from one part to another which, while it proves the existence in them of a specific pathological element, independent of, or at least differing from inflammation, renders them peculiarly amenable to the action of revulsive agents, a chief condition of whose salutary influence is the possibility of displacing the morbid process for the removal of which it is employed.

Theory of Counter-Irritation.—The question in what manner an artificial congestion or inflammation modifies one which is of a morbid nature, is a problem which has at all times been investigated,

but until quite recently without success. The objection was constantly urged, to the most ingenious theories, that one spontaneous inflammation succeeding another in a neighboring part aggravates this latter as well as the general condition of the patient, instead of benefiting either. But this argument ceases to have weight when it is considered that the case in question is very far from being an analogous one to that in which an artificial irritation is produced upon a sound part for the relief of an organ which was previously diseased. In the former case, the very occurrence of the second inflammation is an evidence of the weakness of the system, and the cause of an additional loss of power. So neither does the occurrence of bed-sores in typhoid fever, and in all diseases of a typhoid type, nor the existence of the cutaneous eruption in exanthematous affections, at all relieve internal derangements, because both the one and the other arise from the same morbid cause. It has, indeed, been suggested that the breaking out of an exanthema constitutes a sort of revulsive act, and in evidence of this opinion the subsidence of the febrile symptoms which coincides with the appearance of the eruption, has been pointed out. But the palliation of distress which then occurs might with more propriety be compared to the relief experienced in a limb on the removal of a band which had obstructed the circulation in its blood-vessels. The real action of the eruption is better seen when it has reached its maturity and a secondary fever is developed which is the direct effect of the irritation of the skin, and one of the principal dangers of the affections in which it occurs.

But, apart from all theoretical or analogical illustrations of the subject, the fact is patent that secondary spontaneous inflammations aggravate, while artificial inflammations, duly regulated, palliate or cure those which arise primarily and idiopathically. Now, then, we repeat, is this palliative or curative power exerted? Is it through the vascular system? Undoubtedly we see the blood retreat from the inflamed part, and accumulate in that to which the irritant is applied. But, between these two facts, no connection, save a mechanical one, is, at first sight, apparent, and that is insufficient to explain the phenomenon. Or, if we invoke, as rightfully we may, the intervention of the nervous system, it still remains difficult to explain how the addition of a point of irritation should diminish an irritation already existing. It is only by the laws of the nervous system that the difficulty can be solved. When we study the modes of nervous action, it soon becomes evident that it is never equally intense in two different points at the same time. We cannot attend to two perceptions at the same instant; whether they be mental ideas or sentient impressions,

the stronger eclipses the feebler. This is so true that no fact is more familiar than that a strong mental emotion renders us insensible to bodily pains, and that when several of these latter occur at the same time, the severest only is perceived. It is also well known that the mind is strengthened, and its organ, the brain, enlarged by mental exercise, at the expense of the nutritive functions of the body; that the brain cannot long be powerfully exercised while a large demand is made for vital force by other organs, as those of digestion and locomotion. Thus the activity of the nervous system in one part diminishes its activity in others, and the vigor of the organic processes at the same time. And hence, as secretion and nutrition are directly dependent upon nervous influence, it is easy to understand how an irritation, capable of exciting the inflammatory process, should lessen the activity of a similar process in a neighboring part.

It is a familiar fact that the body is an assemblage of organs which are constantly exerting a reciprocal influence upon one another, so that all are more or less involved in the derangements of each, while every one at the same time has special relations which, when it is diseased, call forth a special group of sympathetic phenomena. The sympathies between the mammæ and ovaries in the female, and between the testes and parotid glands in the male, are familiarly illustrated by the reciprocal transference of morbid states involving congestion from one of these organs to the other. It is an ancient method of treating amenorrhœa, to apply cupping-glasses to the breasts, and it is said that suction of the nipples in a pregnant woman will produce abortion. Examples of sympathy between remote parts, and exerted through the organ of the mind, are innumerable. Emotions of pleasure or shame suffuse the face with blushes, while fear and other depressing passions blanch the cheeks, chill the extremities, bedew the skin with a cold sweat, or even cause the fæces or urine to be voided. So emotions of pity or tenderness make the tears flow; the sight or even the idea of lascivious objects causes erection of the genital organs; the odor or sight of agreeable food, or even the thought of it, makes the mouth water, while disgusting objects turn the stomach, and alarming ones suspend digestion or destroy the appetite. Equally striking illustrations drawn from disease may be adduced of the mutual inter-dependence of distant organs not so directly associated in function as those above alluded to. Obstinate constipation has been overcome by causing the patient to stand upon a wet marble pavement; phthisis has often supervened upon the cure of a fistula in ano, the suppression of an issue, or other habitual discharge, and, still more frequently, apoplexy and other internal congestions have fol-

lowed the same causes. The translation of gout and rheumatism to the brain, heart, stomach, &c., when suppressed in the extremities, is a familiar fact to every practitioner. Internal diseases are sometimes cured by the sudden and spontaneous outbreak of eruptions upon the skin, or by the formation of subcutaneous abscesses. It is true that in several of these examples the existence of a material morbid element circulating in the blood is highly probable, but it is none the less certain that they illustrate one or more of the modes in which nature establishes revulsion.

Until very recently the mechanism of these interesting and important operations was entirely unknown. Hunter, in his interesting chapter upon "Repulsion, Sympathy, Derivation, Revulsion, and Translation," says that the second of these operations, sympathy, perhaps includes the mode of action of the rest. But this term, both etymologically and technically, expresses nothing more than the fact of a *consensus* between organs; it in no wise explains it. Modern science has penetrated more deeply into the secret places and actions of organized living matter. Since the discovery of the relations of sensation to motion through the nervous system, and the demonstration that separate nervous fibres convey in different directions sensory impressions and motor force, it has become evident that all consentaneous organic processes are conducted by and through the nervous system. Without this principle counter-irritation could not exist, and by its means most of the phenomena of this therapeutic agency are to be explained.

But essential as the sympathetic influence is to a comprehension of the effects of irritant remedies, it does not represent them all. If it did, every medicine might be substituted for every other one of the irritant class, due regard being had to its relative degree of irritant power. But it must be said of this as of every other class of the *Materia Medica*, that each individual composing it possesses properties peculiar to itself, either in degree or kind. While many produce effects which, even in their highest degree, are vesication or cauterization, others occasion neither of these phenomena, but a pustular eruption, which, again, may be of different kinds, as the ecchymatous or impetiginous eruption of croton oil differs from the umbilicated pustulation of tartar emetic. Of the action peculiar to the several caustics we shall have occasion to make additional remarks. A still more important difference, because it nearly concerns the specific mode of action of some of these medicines, is that which depends upon their absorption and the development of their characteristic operation. In

the introductory chapter to this work instances were given of the absorption of medicines by the skin, both when the cutis is denuded and when the cuticle remains intact. The most familiar among the striking examples of this sort is cantharides, whose absorption from the skin, when it is used for blistering, is proved by the strangury which it occasions. The precise influence of the absorbed cantharidin as a therapeutical agent is perhaps not well established, but, as is elsewhere shown, this influence is viewed by a large class of writers as a sedative of the nervous and arterial systems. Turpentine and iodine may also be absorbed by the unbroken skin; and the preparations of mercury, tartarized antimony, and arsenic, even when thus applied, but more frequently when placed in contact with the surface of a wound or an ulcer, may develop the symptoms which are peculiar to them when taken into the stomach. The share belonging to this mode of action in the ordinary operation of irritants is not well ascertained, but that it is not inconsiderable in some cases may be regarded as certain.

Elements of the Counter-Irritant Action.—It has been pointed out that one or more of the elements or of the effects of inflammation is involved in every case of treatment by counter-irritation. Each one may also become a special agent of cure. Sometimes pain alone, sometimes the congestion to which redness and swelling are due, sometimes a serous or purulent secretion, and sometimes a disorganization of structure is the efficient element employed. These require a separate examination.

Pain. The cases are numerous in which the irritant action of pain is of great efficacy. Such are those of narcotic poisoning, where mere revulsion would be inoperative, while agents which at the same time excite sudden and severe pain, such as urtication, flagellation, the application of hot substances to different parts of the body, are often successful in restoring sensibility. Other cases of insensibility produced by congestion of the brain have been cured by analogous methods. The moxa, vesication by boiling water or the hot iron, the actual cautery, faradization, &c., have been successful in relieving paralysis for which remedies less energetic and rapid in their operation have been resorted to in vain. The instances in which the pain of disease has been neutralized by pain excited as a counter-irritant are made familiar by daily experience; for it cannot be doubted that the efficacy of mustard and ammonia in assuaging the pain of inflammatory or even of nervous congestion is quite as much attributable to the new pain which they excite as to their revulsive withdrawal of blood from the affected part. Even decided pain is not a necessary element of the derivative influence, as Hunter says: "I have known, in a nervous girl, a pain in one arm cured by rubbing the other."

Congestion. The congestive element of inflammation may be removed by irritation applied either directly to the inflamed part, or at a distance from it. The latter of these methods is counter-irritation or revulsion, the former is substitution.

Substitution is a method of cure which has at all times been practically recognized, although not always defined, nor even described. Thus, Hunter speaks of a mode of local cure "which is by producing an irritation of another kind," and adds that there "is in such modes of cure still a larger quantity of inflammation in the part than was produced by the disease." Again, alluding to the inefficacy of this method in the local treatment of constitutional affections, he remarks: "If the artificial disease is not of the same nature with the constitutional one, then it cannot act as a *substitute* for it."¹ This passage defines the doctrine and furnishes a name for the method treated of in the present article.

The therapeutical method of substitution is one of potent energy, but which is adapted only to the early stage of inflammation, while yet the blood is almost entirely confined within its vessels, and before the distension of these latter has impaired their contractility. The influence of diffusible stimulants in scattering, as it were, the earliest tendencies to internal congestion and inflammation is familiarly exhibited in the effects of alcohol and heat upon persons benumbed with cold and beginning to suffer pain in some internal organ. Thus, a draught of some alcoholic liquor frequently dispels the gathering elements of perhaps a fatal inflammation. The analogous influence of external heat, which belongs to the class of irritant medicines, is even more familiarly observed in the instinctive approach to the fire of persons who are the subjects of impending inflammation, a movement prompted by the sense of chilliness which precedes a complete stasis of the blood. That this influence is not to be measured by a mere elevation of temperature, but depends upon a vivid impression upon the nervous system is proved by the fact that in frost-bite and in the cold stage of algid intermittents, cold applications, such as cold water or snow, employed with friction, are more useful than such as are above the usual temperature of the body. In these and in all similar cases there is every reason to believe that the sensitive nerves stand in the same relation to the nerves of the bloodvessels as to the common nerves of muscular motion,² and that through these nervous relations all stimuli, whether by a direct or an indirect action, excite contraction of the bloodvessels, and thus produce the resolution

¹ Edit. cit., iii. 372.

² SNELLEN, Virch. Arch., xiii. 109.

of engorgements. But this, we repeat, is possible only so long as the blood is contained within its vessels, or, at most, when the effusion, if any, is still in a liquid state. When the serous effusion has solidified or is excessive in quantity, the application of stimulant agents so far from promoting resolution of the inflammation, can have no other effect than to augment it, and render almost inevitable what else might have been avoided, suppuration of the inflamed parts. This remark, however, is more applicable to parenchymatous than to membranous inflammations, because in the former the effused liquor sanguinis is all retained, while in the latter it is for the most part discharged.

That a local stimulant treatment is successful chiefly in recent inflammations, is demonstrated by daily experience. Every day we see inflammations of the eye, nostrils, fauces, vagina, urethra, &c., arrested in their forming stage by the substitutive use of stimulant remedies; but it is unfortunately quite as common to witness the aggravation of such affections by the applications referred to, either because the period at which the inflammation was capable of dispersion had gone by, or because the strength of the stimulant was not duly proportioned to the susceptibility of the diseased part. It, therefore, becomes a very important problem in practice so to adjust the power of the application, and to employ it so opportunely that it may remove the original inflammation without exciting in its stead a still more intractable one. On the other hand, it is equally essential to the success of this method, not to suspend its application long enough to allow the primary disorder to renew its activity; for this latter may then return with renewed violence, and produce changes of so permanent a nature as to require a totally different management for their removal. It is also to be remembered that when an inflammation has for some time occupied the same part, the nerves become accustomed to its presence, the bloodvessels are permanently enlarged, the nutrition of the textures is affected, and consequently a much more powerful agent than at first is needed to restore its normal condition. This is familiarly illustrated by inflammation of the conjunctiva, which, in its first stage, readily disappears under the use of some mild stimulant, such as a very weak solution of wine of opium, or of acetate of zinc in water; but by degrees the inflamed membrane loses its susceptibility to such feeble stimuli, stronger solutions of the same agents are necessary, and at last, when a granular state of the membrane exists, nothing less than the sulphate of copper, the nitrate of silver, or other powerful stimulant, will restore the healthy condition of the part.

But although it frequently happens that the stimulants employed are not strong enough to cure a local inflammation, it is quite as often

observed that the morbid process is maintained and indefinitely prolonged by the protracted use of such remedies. No doubt this often arises from a change having taken place in the sensibility of the part. The first application of the stronger stimulants imparts a renewed vitality to the indolent tissues; but if their use is persisted in, they excite a new morbid condition of indefinite duration. On the other hand, their mere withdrawal allows the reparative forces of nature to act without hindrance, and the cure is completed. In the employment of stimulants for the cure of chronic inflammation, few rules of practice are more important than this: occasionally to suspend all treatment, and study the condition and tendencies of the disease. Even when this intermission of remedies is not of itself sufficient for the cure, it enables us to learn what modifications of the method previously adopted will be apt to succeed.

The cases in which stimulant applications are made directly to an inflamed tissue, for the purpose of curing it, are exceedingly numerous. Nearly all primary inflammations of the skin and mucous membranes are of this sort, for, on examining the catalogue of remedies used in their treatment, we find very few that do not belong to the class of stimulants. In fact their employment has always formed a popular method of curing such diseases. The stimulant plan of treating erysipelas and burns was borrowed from the custom of managing these latter which prevailed among the colliers of England. Inflammations of the eyes, nostrils, mouth, fauces, vagina, urethra, and rectum, to say nothing of those affecting the mucous membrane of the respiratory organs, and of the stomach and bowels, are most frequently subjected to treatment by this method, which, when applied with judgment and discretion in regard both to time and degree, occupies the very first rank among therapeutic agents. We have said it is applicable almost exclusively to primary idiopathic inflammations. When it is used to cure external affections depending upon a vice of the system, it almost uniformly fails; as Hunter says, "being prevented from settling" upon the part to which the application is made, "they return upon the constitution again, and often fall upon some other part." This is the case with gout and rheumatism in their local manifestations, and often with diseases of the skin. In such affections the directly irritant treatment is seldom advantageous unless to recall to its original seat the morbid action which has gone to attack some more important and perhaps vital organ.

It was a distorted and exaggerated perception of the principle of substitution in the cure of disease that led Hahnemann to adopt it as an exclusive dogma, and to link with it another, the doctrine of in-

infinitesimal doses, with which it has no natural or logical connection, and finally to burden these with the weight of a third article of faith, the hypothesis of "psora," which marks the anti-climax of an ill-regulated mind in its natural descent from the impossible to the absurd.¹

Counter-irritation.—Besides producing pain, irritants, as we have seen, by their influence on the nervous system, occasion an afflux of blood to the irritated point, and thus may be used *revulsively* to diminish congestion in overloaded organs. As the extent of surface of the skin upon which they act compensates for the inferior energy of their action, mild revulsives are often used with singular advantage when thus applied. This is strikingly true of warm water, employed as a general or a partial bath in cases which demand a relief for the congestion of internal organs, or in which the remedy may be applied to one part of the body, in order to free a distant one from the congestion which constitutes the first stage of local inflammation. Thus, the foot-bath or hip-bath draws away the oppressive load which gorges the bloodvessels of the brain, the nasal cavities, the throat, chest, &c. If its temperature be no higher than is pleasant to the feeling, its action is limited to the effect described, but if it be in any degree painful, stimulation ensues, and the nervous system, instead of being soothed, is excited.

¹ The fact that, under appropriate circumstances, a cause competent to produce certain effects is also competent to remove them, has at all times been recognized by the popular as well as by the medical mind. The Latin poet, Syrus, writes, "Pro medicina dolor est, dolorem qui necat;" and in another place, "Remedio amaro amara bilem diluunt."

Baccius (*De Thermis*, p. 413) states that the following distich was inscribed upon the walls of the ancient baths:—

"Balnea, Vina, Venus, corrumpunt corpora sana.
Corpora sana dabunt, Balnea, Vina, Venus."

But the most striking illustration of the doctrine that, under fitting circumstances, an artificial excitement will neutralize a morbid one of the same nature, is afforded by the following passage from Shakspeare, in whose writings there seems to be the germ of every description of knowledge:—

"In poison there is physic: and these news,
Having been well, that would have made me sick,
Being sick, have in some measure made me well;
And as the wretch whose fever-weakened joints,
Like strengthless hinges, buckle under life,
Impatient of his fit breaks like a fire
Out of his keeper's arms; even so my limbs,
Weakened with grief, being now enraged with grief,
Are thrice themselves."

Second Part of King Henry IV., Act I., Scene 1.

The effects of counter-irritation of a moderately high grade have already been pointed out as consisting in part of the stimulant action of pain. Within certain limits, which, of course, must vary with the natural susceptibility of the patient's constitution, or that which is impressed upon it by disease, this agency has been seen to exert a salutary influence. It may be further remarked that when a stimulus, which might operate beneficially upon a limited region of the body, is extended to a large portion of the cutaneous surface, its action may be such as completely and fatally to destroy all sensibility by the shock which it gives to the nervous system. In this manner, extensive burns and scalds, although slight in degree, frequently extinguish life after having annihilated sensibility in the skin.

Between the two extreme degrees of operation above referred to, may be considered those forms of counter-irritation which involve inflammatory elements, and may be accompanied with more or less disorganization, but which, by reason of their limited extent, do not inflict a great or lasting injury on the system. These forms include rubefacients, vesicants, setons, issues, &c., in a word, all agents producing a discharge from the skin, or a more or less permanent alteration of its structure. It is, in general, by their degree of concentration, and the duration of their contact with the integument, that they manifest their peculiar powers. By their means we may obtain a great variety of effects; simple derivation without pain, transient congestion, or this condition in a more permanent form, and accompanied with various degrees of pain from the most trifling to the most intense, and more or less general excitement of the system. To these phenomena may be added vesication followed by exposure of the derm, and also destruction of the skin by ulceration or gangrene. In all of the latter cases the depletory operation of the irritant is the most important, for it not only diminishes the bulk of the circulating fluid, but also changes the direction of its pressure. It is best adapted to the cure of the results of inflammation, while congestive derivation is more efficient in the forming stages of this process.

In regard particularly to the method of revulsion or counter-irritation, the important fact is to be remarked that it exerts no influence whatever upon ulcerative changes of structure. It is also to be borne in mind that the degree of irritation usually required by this method would, if applied directly to the seat of inflammatory disease, infallibly hurry it into disorganization by adding to the fixed effusion a fresh congestion and additional exudation matter. Its object may be only to draw away from the original seat of the disease a portion of that excess of activity which is urging it towards more permanent and

serious changes; and to effect this object, revulsion establishes its operations upon a sound part, the best calculated by its position to control those actions which it is intended to remove. Too near, it must add fuel to the flame; too far off, it may inflict useless suffering. The precise position in which it should be placed can be determined by experience alone, and from this we learn that its distance from and relation to the seat of disease must be governed chiefly by the nature, extent, and intensity of the affection, and the sympathies of the organ involved.

In regard to the *nature* of the disease, it may be remarked that the method in question is hardly applicable to any case of inflammation, the cause of which is not confined chiefly to the affected part. Hence it exerts comparatively little influence upon the local developments of idiopathic general diseases, whether fevers or dyscrasiæ. But it acquires its value anew in these affections in the treatment of the intercurrent inflammations with which they are liable to be complicated. Thus it has much less influence upon the tonsillitis which accompanies scarlatina, than upon that produced by cold; less upon inflammation of the meninges, pleura, or peritoneum, arising in the course of phthisis than when these affections have an independent origin. In such cases the counter-irritant treatment is not without a salutary influence, but it is very inferior to that which it exerts in idiopathic diseases of the same name. The reason of this inferiority evidently is that a cause is in operation tending constantly to maintain or renew the inflammatory action.

The *stage* of disease affects the utility of counter-irritant agents. We have seen that derivation by congestion is peculiarly applicable to the forming stage of diseases in which there is a local determination of blood; but, whenever this stage has passed, when effusion at the seat of disease has taken place, and the system, reacting under this stimulus and the concomitant change that affects the blood, and the general nutritive function, presents febrile phenomena, the use of counter-irritant applications is no longer opportune, and indeed by adding to the excitement of the system, may greatly aggravate the disease. But when the intensity of the febrile action has subsided, and the pulse become softer and less frequent, without any threatening decline of the patient's strength, an appropriate moment for the use of counter-irritation has arrived. It is true that almost the only agent employed under these circumstances is cantharides, and that its influence upon the system is far from being represented by its counter-irritant effects. The other members of the class are almost entirely restricted in their use to cases of which fever is an accidental element,

cases of chronic inflammation, or again of departures from normal nutrition.

The *extent* of a diseased part affects the question of employing counter-irritation for its cure. As a rule, the less the extent of the disease the more amenable is it to this mode of treatment. It is a most commonly used and efficient remedy for all local inflammatory affections of the organs of the special senses, the larynx, &c., and in all local pains and functional disturbance in nearly every other part of the body, including neuralgic, neurotic, and rheumatic disorders, and derangements of secretion. But its usefulness is not limited to cases of this description. The striking cures which have been made of inflammation of the membranes of the brain by using cantharides, tartar emetic, or croton oil as a counter-irritant applied to the entire scalp; the familiar examples of rapid cure by similar means of suffocative or of chronic bronchitis occupying the whole lining membrane of the lungs; the striking advantages of blisters covering the abdomen in some cases of peritonitis, hysteritis, and dysentery, do not permit us to entertain any doubt of the great, if not the uniform, efficacy of these remedies.

The *constitution* of the patient modifies the effects of counter-irritant remedies. As a general rule, persons of a nervous and irritable habit support them ill. Such persons have an exaggerated cutaneous sensibility, with a certain delicacy and fineness of the skin, which not only renders them intolerant of the pain, but very liable to the fever and general nervous derangement produced by these applications, and to excessive inflammation and even gangrene of the parts on which they act. These remarks apply to delicate females and young children, and hence extreme caution should be observed in their treatment by such remedies. The former are most apt to be injured by the pain and the excitement which results from it, the latter by an injury to the texture of the skin. In another place the liability of the integument to gangrene under the prolonged action of blisters will be pointed out, and its peculiar tendency to be affected with erythematous, vesicular, and pustular eruptions by the same cause. These eruptions are not always confined to the irritated surface and its immediate neighborhood, but may also appear in remote situations, a fact which it is difficult to explain without admitting the absorption of a certain portion of the irritant principle. This case appears to present a certain analogy to that which is sometimes observed as a consequence of vaccination, when similar eruptions make their appearance for the first time after this operation, and are apt to be attributed to the quality of the virus employed. In both cases there is greater probability that the eruptions in question are due to some strumous or other vice inherent in the

patient's constitution, and less frequently to some transient derangement of the system. However this may be, it is unquestionably the part of prudence never to apply any but the milder forms of cutaneous irritants to persons who have a fine and delicate skin with great nervous susceptibility, and especially to infants and young children.

The Depletory Action of Irritants.—Various irritants, in different grades of their action, produce a discharge of blood-plasma from the integument. Wherever, then, an exudation exists in which pus is capable of forming, the blood is robbed of the most important elements of nutrition. Consequently the agents which effect this purpose are in a high degree depletory, and must tend to diminish the vigor of the system generally, and, in an especial manner, to hinder the nutrition of the organs upon which they more immediately operate. They act by drawing away the blood from neighboring parts, by means of the irritation which they excite. If a drain thus created affect the nutrition of the whole body, even in its soundest parts, much more must it influence those portions of the economy which are the seat of congestion by blood or exudation matter, and which, by the very presence of these, in a measure, foreign bodies, are deficient in tone and recuperative power. The establishment in their neighborhood of a serous or purulent discharge makes an unusual demand upon them to supply the loss, and necessarily the least organized elements within reach of the bloodvessels are first seized upon to repair the waste. This is a law of the whole system. It is familiarly illustrated by what takes place in partially consolidated fractures and wounds when any unusually exhausting influence comes into play. Then the callus or other provisional bond of union wastes away, and the surfaces of the solution of continuity are once more disunited. The contrary effect is exhibited when a seton introduced between the ends of a fractured and ununited bone, or an issue in the immediate neighborhood, occasions a deposit of callus and the solidification of the fracture.

The nature of the action exerted by irritants belonging to this category is evidently a double one, for it is revulsive as well as depletory. In acute diseases this operation is seldom invoked, except by means of blisters, which are powerfully revulsive if they are large and allowed to remain long enough upon the skin. But they at the same time abstract an abundance of serum, and afterwards of pus. The blistered surface is often prevented from healing, and made to furnish a large quantity of pus, by means of various irritating substances, such as mezereon, savine, resin, &c. But the more permanent forms of depletory revulsion are those in which a small wound in the skin is made to suppurate abundantly by means of mechanical irritants, as

strands of silk and peas in the case of setons and issues, and aided by some one of the medicinal irritants above alluded to. Formerly, more than at the present day, these agents held a high rank among remedial means, and they were regarded as affording apt illustrations of the truth of the humoral doctrines which then held exclusive possession of the medical world, inasmuch as they appeared to evacuate from the system the peccant humors which were supposed to circulate in the blood and constitute the material essence of diseases. The researches of modern pathologists, without having directly sanctioned this doctrine, have at least lent it some countenance by pointing out how much health depends upon an elimination of various deleterious because effete substances from the blood through the excretory organs. But, so far as we are informed, there is no direct proof that any such excretion takes place, as a general rule, through artificial exutories. They discharge pus in various quantities, and containing variable proportions of the ordinary constituents of pus; and sometimes odorous and other substances, which are susceptible of elimination with the perspiration, are evidently mingled with the purulent secretion: but there does not appear to be any discharge by such outlets of the ordinary or extraordinary constituents of the bile or urine.

The diseases to the cure of which exutories are most applicable are chronic inflammations and habitual determinations of blood, whether or not they are associated with heterologous nutrition. To enumerate these diseases would be to recite nearly the whole of the nosological catalogue, except idiopathic fevers, for there are few affections in which morbid determinations of blood and their consequences do not play an important part. It is of more moment, in this place, to indicate an objection to their use under certain circumstances. This does not refer to their transient employment, in the form of blisters, in acute disorders, but to their prolonged use in chronic affections, whether for the purpose of removing or of preventing local disease. The habit of spoliation which they establish can seldom be laid aside abruptly with impunity; its suppression is immediately followed by a plethoric condition of the system, and most usually the very organ for whose protection the exutory was established is the first to suffer from its suppression. This is familiarly and strikingly the case in cerebral disorders. No sooner is the revulsive and depletory action of the remedy suspended than congestion of the brain begins to take place, and, unless active means are taken to avert it, apoplexy is pretty certain to result. Hence it is, we repeat, that this is a form of revulsion, to be safely used, must be used cautiously, never established without sufficient cause, and never desisted from without the creation

of some supplementary evacuation by depletion, purging, or diuresis, or else by hygienic means adapted to prevent the undue production of blood, and especially its accumulation in particular organs.

The Escharotic Action of Irritants.—Escharotics, or caustics, are substances which destroy the vitality of the part to which they are applied. In doing so, they necessarily produce the stimulant, counter-irritant, and depletory effects which have already been considered, and, in the case of issues, they are expressly employed to create a permanently suppurating point. Between the greater number of escharotics and other irritants there is this essential difference, that whereas the latter operate only by producing an exaggerated but still natural action, and which, when excessive, may result in the death of the part, the former act by combining with the elements of the tissues, and thus destroying their organization. The portion so destroyed, and which must then of necessity be cast off, is called an eschar. Escharotics, it is true, when sufficiently diluted, act as stimulants only; but in that case their mode of action is no longer the same, for they do not affect the integrity of the tissues. Thus, the most beneficent and familiar of all stimulants, caloric, becomes, when of a high degree, the most potent of escharotics, violently decomposing the ultimate organic elements of which the body is composed. A similar statement is applicable to alkaline, acid, and metallic caustics. In various degrees of dilution they become stimulants, rubefacients, vesicants, or escharotics; but in the last, we repeat, their mode of action is peculiar, for it cannot be admitted that between any condition short of disorganization, and disorganization itself, there is only a difference of degree.

Mr. Bastick has proposed a division of caustics into two classes, and the division appears to be well founded.¹ One class comprises those which merely kill the living tissue, as the chloride of zinc, sulphates of copper and zinc, bichloride of mercury, &c.; the other includes those which also decompose the tissue, dead or living, as caustic potassa, nitrate of silver, chromic acid, &c. Agents of the first class also become antiseptics or preservatives of the tissue, whose vitality they have destroyed, while those of the second form new compounds out of its elements, as potassa does with the fibrin and albumen of the part. Hence, the latter are to be selected when a destructive operation is proposed.

The chief uses of escharotics are, to establish suppurating surfaces

¹ Times and Gazette, April, 1858, p. 371.

for the sake of their revulsive and depletory effects, to arrest hemorrhage, to open abscesses, to destroy tissues which are inordinately developed, although normal in their nature, to remove morbid heterogeneous growths, and to convert poisoned into simple wounds. As these various topics will be treated of in connection with the several articles of the escharotic class, it is unnecessary to dwell upon them here.

In concluding these remarks, introductory to the consideration of individual irritant medicines, we once more repeat the observation that every member of their class has powers peculiar to itself, which forbid the indiscriminate substitution of one of them for another. All are powerful medicinal agents, and each, in its appropriate place, is capable of rendering the most valuable aid in the treatment of disease. Two are pre-eminently useful, cantharides and nitrate of silver, since they are adapted to the treatment of a greater number of diseases than any others of the associated medicines. Two, which are also of great value, oil of turpentine and croton oil, are not treated of in the present division, but the former in the Class of General Stimulants, and the latter in that of Cathartics. The irritant properties of tartar-emetic are described in the Class of Emetics.

Irritant remedies are derived from the three kingdoms of nature, and we propose thus to divide them, although here, as elsewhere, the several groups so constructed are not rigidly defined. Thus, ammonia is found in all three of the natural kingdoms, and soda, potassa, lime, &c., in at least two; while tartrate of antimony and potassa is composed of three elements, of which one is always of vegetable, and another of mineral origin. This classification is, however, a useful one, not only because it aids the memory in search of various agents of analogous qualities, but because these qualities often depend upon similar active principles in the organic, and upon similar chemical elements in the inorganic class.

IRRITANTS CHIEFLY FROM THE MINERAL KINGDOM.

ACIDUM ACETICUM.—ACETIC ACID.

ACETUM.—*Vinegar.*

SOURCES.—Acetic acid is peculiar to the organized kingdoms, where it is found free in the juices of several plants, or else combined with potash, lime, or ammonia. According to some physiologists, it exists in the gastric juice, the milk, urine, and perspiration, but Pereira is of opinion that, in most if not all of these cases, lactic acid has been mistaken for acetic acid.

It is also a product of one of the forms of fermentation, hence called acetic. This is the source of the common cider and malt vinegar. A similar but purer product is obtained by the fermentation of inferior wines. Common vinegar contains about five per cent. of acetic acid. For other than domestic purposes, it is obtained on a large scale by the acidification of alcohol, or the destructive distillation of wood. The purest acid is procured by decomposing acetate of lead by means of sulphuric acid, which combines with the lead, while the liberated acetic acid is removed by distillation.

PROPERTIES.—Acetic acid is a colorless, inflammable, volatile liquid of a pungent, fragrant, but sour smell, and a sharp acid taste. It unites with water in all proportions, and, to a certain extent, with alcohol. It evaporates gradually, and hence must be kept in closed bottles. It is wholly volatilized by heat.

HISTORY.—Vinegar appears to have been very anciently known. A part of the vow of a Nazarite was that he should "drink no vinegar of wine or vinegar of strong drink."¹ Hippocrates speaks of its use as a fomentation in injuries of the joints, in recent wounds and bruises, in certain cutaneous diseases, including the leprosy, warts, &c.² According to Dioscorides,³ vinegar is refrigerant and astringent, agreeing with the stomach, augmenting the appetite, and suppressing hemorrhage. It may be used, he says, internally or externally. It assists digestion, and when applied on a sponge, or a pledget of wool, to

¹ Numbers vi. 3.² De Humidorum usu.³ Lib. v. cap. xvii.

recent wounds, it controls their tendency to inflammation. It restrains prolapsus of the rectum and navel, and fortifies spongy gums. It is a useful application to unhealthy and corrosive ulcers, and associated with other medicines, is serviceable in various eruptions of the skin. Warmed and mixed with sulphur, it is beneficial in gout, and, associated with honey, may be used to disperse ecchymoses, and remove discolorations of the integument. As a lotion, it moderates heat of the head. Vapors of warm vinegar are serviceable in dropsy, in hardness of hearing, and in ringing of the ears. When dropped upon insects, in the auditory canal, it destroys them; it heals the pannus, and is useful as a local application to the stings of venomous insects and the poisoned bites of animals. When mixed with salt and drunk warm, so as to excite vomiting, it is serviceable in poisoning by opium, conium, and poisonous mushrooms. Sipped or inhaled, it destroys leeches that may be hanging in the throat. It quiets chronic coughs, but aggravates the acute. Its warm vapor is a palliative in some forms of orthopnoea. As a gargle, it moderates excessive secretion in the fauces, and also relieves the quinsy and relaxation of the uvula. It palliates the toothache when used as a mouth-wash.

Galen declares vinegar to be injurious to the nerves, because it impoverishes the blood. He alludes to the irritant action of strong vinegar. According to Rhazes, vinegar thins the inspissated humors, dries the bowels, and assuages thirst. It is apt to produce flatulence, but excites the appetite, and quickens the digestion. It diminishes the seminal secretion when used immoderately, and prevents corpulency. Other Arabian physicians assert it to be hurtful in nervous, thin, and pale individuals.¹

ACTION. *On Animals.*—According to the experiments of Mitscherlich, a rabbit, to which acetic acid had been administered, suffered from feeble respiration, great debility, and spasms, in which state it expired suddenly. One ounce of Prussian acetic acid killed a large rabbit in seven minutes; half an ounce killed a small one in eleven minutes; two drachms another in an hour and a half; and one drachm another in about four hours. The dose of half a drachm did not cause death. In his experiments with distilled vinegar, he found that six drachms killed a small rabbit in eight hours, and that half an ounce did not cause death. The tunica propria of the intestines was found softened, and of a brownish-red color.

On Man.—The local action of acetic acid is that of an astringent and stimulant. In a concentrated form and applied to delicate and sensi-

¹ EBN BAITHAR, Heil- und Nahrungsmittel, i. 377.

tive tissues it is very irritating and almost caustic. When diluted it penetrates the epidermis without dissolving it, and by this means may be absorbed into the system. In moderate quantities and sufficiently diluted, and not too frequently used, it increases the appetite and facilitates digestion, as Dioscorides so long ago affirmed of it, and quenches the thirst. According to Vegetius, the Roman armies, during their campaigns in the East, carried with them a stock of vinegar with the twofold object of relieving the soldiers' thirst when the weather was very hot, and of preserving them from intermittent fevers.¹ But employed incautiously it weakens the digestive powers, though less than the mineral acids do, and sooner or later induces eructation, heartburn, loss of appetite, diarrhoea, emaciation, and debility. According to Morgagni, it may occasion thickening of the coats of the stomach. The injurious influence of vinegar on the nutrition of the body is shown in the following case, related by Portal.² "A few years ago, a young lady, in easy circumstances, enjoyed perfect health; she was very plump, had a good appetite, and a complexion blooming with roses and lilies. She began to look upon her embonpoint with suspicion, for her mother was very fat, and she was afraid of becoming like her. Accordingly she consulted a woman, who advised her to drink a small glass of vinegar daily; the young lady followed her advice, and her corpulence diminished. She was delighted with the success of the remedy, and continued it for more than a month. She then began to have a cough, but it was at its commencement, and was considered a slight cold which would go off. Meantime from dry it became moist, a slow fever came on, and a difficulty of breathing; her body grew lean and wasted away; night-sweats, swelling of the feet and of the legs succeeded, and a diarrhoea terminated her life. On examination, all the lobes of her lungs were found filled with tubercles which somewhat resembled a bunch of grapes." An instance of the same sort is related by Desault;³ Foderé tells us,⁴ that in Germany there was a sort of quacks who professed to relieve persons who suffered from inordinate obesity. They prescribed large doses of vinegar for the purpose, and if they sometimes fulfilled their promise it was at the expense of disorders which sooner or later put an end to their patients' lives. Sunderlin affirms that the workmen in vinegar factories acquire a cachectic look, and soon become consumptive. I saw, says this writer,⁵ in a family that lived hard by a manufactory of vinegar, three of the children die successively of a phthisical inflammation of the lungs; and

¹ PRINGLE, *Diseases of the Army*, p. 112.

² *Lond. Med. Gazette*, April, 1839, p. 176.

³ MÉRAT and DE LENS, *Dict. cit.*, i. 28.

⁴ *Dict. en 60 vol.* lviii. 132.

⁵ *Handbuch der Spec. Heilmittel*, 3te aufl., i. 73.

two others who were already diseased were only preserved by a timely removal. This fact would appear to be an exceptional one, for Pereira, who inquired among the workmen in a large vinegar factory in London, found the notion of the injurious influence of the vapor generally repudiated by them.

An attempt has been made by modern chemists to explain the effects of acetic acid. According to some, on its passage into the blood, it is converted into lactic acid. It is thought to act chemically on the food and cause its solution, for it is undoubtedly a solvent of fibrin, albumen, and gelatin, the chief constituents of animal food. Its tendency to produce emaciation and its power of moderating vascular action are also attributed to its solvent action on the fibrin of the blood. Its faculty of assuaging the thirst is ascribed to its augmenting the secretion of the salivary and the mucous glands.

As regards the poisonous effects of acetic acid, they are so seldom witnessed that, as Mr. Taylor remarks, this acid has generally been excluded from the class of poisons. A case is cited by Orfila, however, in which decidedly toxic symptoms were manifested.¹ A person who was recovering from an attack of pneumonia swallowed a spoonful of strong acetic acid. He shrieked with pain; the interior of his mouth was whitened, and his thirst intense; there was a burning pain in the chest and abdomen, nausea, and subsequently vomiting and diarrhoea, inability to speak, profuse sweating, and a small, quick pulse. Notwithstanding the feebleness of the patient when the accident occurred, he entirely recovered. There does not appear to be any case on record in which this acid was unequivocally the cause of death.

The recommendations of modern writers, touching the dietetic use of vinegar, do not differ essentially from those of the ancients, which have already been quoted. It is advised for persons who are not very thin nor irritable, and especially in warm weather, or along with a full meat diet; but it is universally disapproved of when the digestion is weak, and when there is a tendency to colic and diarrhoea. Anemic and chlorotic females should sedulously avoid its use, although they have sometimes an insatiable longing for it. Nursing mothers, also, ought to partake of it very sparingly, for cases have occurred of fatal diarrhoea in the infant arising from acidification of the breast-milk by this article.

REMEDIAL USES. *Internally.*—*Fevers.* Owing to its liability to produce colic and diarrhoea, acetic acid is much less generally used

¹ Toxicologie, i. 258.

than other vegetable acids, particularly lemon-juice, and less even than the mineral acids. It may, however, be prescribed in febrile affections generally, but the symptoms which especially indicate it are heat of skin and excessive thirst. By moderating the fever it palliates these symptoms, and when much jactitation exists, tends to promote calmness. The most general application of the remedy to this class of diseases has been in typhus and other malignant fevers, owing to its supposed possession of so-called antiseptic virtues. Mindererus, Diemerbroeck, and, to some extent, Pringle,¹ supported this opinion, but there is nothing to prove its validity. It palliated the fever, as already explained, but nothing more.

The employment of vinegar vapors as a means of destroying *contagion* is an ancient method which has but recently been superseded by the use of chlorine. Vinegar was sprinkled over the floor and furniture in sick-rooms, or its vapor was diffused from hot iron, from live coals, or from cloths hung near the beds of the sick. It is now, or it very recently was, the custom in the Mediterranean parts of Italy, France, Spain, &c., to subject letters received from the Levant, when the plague prevailed in that region, to a thorough fumigation with the vapors of vinegar.

Hydrophobia. A large number of reports have been published of the cure of hydrophobia, from the bite of a mad dog, by means of large draughts of vinegar, injections of the same, baths of its hot vapor, &c. It is not possible either to affirm or deny the truth of such statements, but all recent experience tends to deprive them of their credit.

Narcotic and other Poisoning. Vinegar has been regarded as an antidote to almost every variety of poison, but to those of the narcotic class especially, including stramonium, belladonna, strychnia, and opium. On the other hand, this doctrine has been denied by the most eminent toxicologists. It would seem that a distinction is to be made. Experiments upon animals do not show that acetic acid diminishes the violence of the symptoms occasioned by narcotic poisons, but rather the reverse. In the human subject, too, its effect is decidedly injurious. Thus, for example, in a case of poisoning by opium, quoted by Mr. Taylor,² vinegar was given in repeated doses, but served only to increase the stupor and other bad symptoms. But if the stomach have first been freed from the unabsorbed narcotic, so that the acid no longer facilitates its action by dissolving its poisonous principle, in that case the stimulant operation of the former may prove salutary. The

¹ Diseases of the Army, p. 267.

² Med. Jurisprudence (Am. ed.), p. 487.

Rasorian school, while insisting on the antagonism of vinegar to opium, maintain that it augments the poisonous action of conium, belladonna, strychnia, and the acro-narcotic agents generally.

In poisoning by the *caustic alkalies* and *earths*, and their carbonates, acetic acid or vinegar, is the proper antidote, because it forms with these substances innocuous acetates. These acids have both been used with decided advantage to allay the severe abdominal pain of *lead colic*, particularly when a partial evacuation has been procured by purgatives. In some cases the acid appears to have determined the action of the cathartic medicines administered.

Vinegar is said to have the power of dissipating the *intoxication* produced by alcohol, but we do not find it recommended by those who have treated professedly of this subject. The same remark may be made of the use of vinegar in *mania*. In *scurvy*, this acid would seem to have been but little used. Dr. Kerr says it appears to have exerted little, if any, power over the disease, unless combined with nitrate of potassa.¹ It was recommended by Haller as a remedy for *obesity*, but, as already shown, its mischievous effects more than counterbalance its advantages in this case.

Acetic acid and strong vinegar have long been used as stimulants to the olfactory nerves and the Schneiderian membrane, to calm agitation, relieve headache, dispel faintness, and to prevent infection. A perfume, made by distilling vinegar with various aromatics, and with camphor, is a favorite preparation of the sort in France. It is known as *vinaigre des quatre voleurs*, a name which it derived from an incident during an epidemic of the plague of Marseilles. It is said that four thieves, who went plundering from house to house, escaped the contagion of the disease by constantly smelling at the preparation, to which their adventure gave a name.

Crystals of sulphate of potassa, impregnated with acetic acid and some aromatic essence, may be inclosed in smelling-bottles, for the same uses as ordinary smelling salts. The emanations of acetic acid have been used as a stimulant to arrest the development of *coryza*. Ammonia and the terebinthinate preparations answer the same purpose.

Externally.—In *fevers* of a typhoid type, with languid capillary circulation, a doughy feel of the skin, and profuse sweats, vinegar may be applied to the whole body, or only to the extremities and face, and either cool or warm, according to the temperature of the skin, and of the air. This lotion, if very acid, acts as a stimulant, but when

¹ Cyclopædia of Med., iii. 697.

much diluted, and applied to the hot, dry, and injected skin of patients laboring under typhus or scarlatina, it appears to be more efficient than aqueous lotions, in lowering the temperature of the body and quieting restlessness.

This acid is very beneficial in passive *hemorrhages*, or those depending upon an altered state of the blood, particularly in hæmoptysis, hæmatemesis, and uterine hemorrhage. For epistaxis, it may be employed by snuffing into the nostrils, or, better, by laying thin compresses, wet with vinegar and water, upon the exterior of the nose. In other hemorrhages there is no comparison between its efficacy and that of the acetate of lead. In bleeding from the womb or lower bowels, it may be applied directly by injection, or, in the former case, by means of a tampon, while cloths, wet with vinegar and water, are laid upon the adjacent parts, to produce cold by evaporation. In a case of uterine hemorrhage after delivery, caused by the prolonged adhesion of the placenta, Mojon injected very cold vinegar and water by the umbilical vein. The contractions of the uterus were at once aroused, and the hemorrhage ceased. The same effect would probably have been produced by cold water alone.

A mixture of vinegar and water is of universal use as a local application to *bruises*, *sprains*, superficial *cuts* and lacerations, *fractures*, and limited inflammations. It should be applied to the part, upon lint or charpie, as soon as possible after the injury has been received, or the signs of inflammation manifest themselves, so as to prevent, by its evaporation, the occurrence of swelling, ecchymosis, &c. The addition of a small quantity of alcohol to the mixture will render it more efficient. This method is particularly useful in injuries of the head; for it not only moderates the external inflammation, but also protects the brain from this process, and from congestion. The lotion should be applied to the shaven scalp. In superficial *burns*, lotions of vinegar and water afford sensible relief, but not so much as the exclusion of air by means of raw cotton. They are also very efficient in preventing the development of *milk abscess*.

Compresses wet with vinegar and water, and bound upon the temples, palliate the pain of *headache*, both of the inflammatory and the neuralgic forms. A weak mixture of the same kind may be instilled into the *eye*, to remove particles of lime adhering to the conjunctiva. Involuntary *seminal emissions* have sometimes been arrested by applying a sponge, wet with strong vinegar, to the perineum, and maintained in that position for several hours. This result, it may be surmised, depends chiefly upon the counter-irritant effect of the vinegar, yet, in

some degree, also, to the refrigerant action of the liquid when first applied.

Strong acetic acid has been used to soften and remove *warts*, *corns*, &c., which it does by its affinity for the albumen of which they are composed; it has also been employed to *blister* the skin, but cannot be recommended for this purpose. As a lotion in ringworm of the scalp (*porrigo favosa*, *favus*) it is of great service; according to Pereira, one or two applications of it usually suffice to effect a cure. In a diluted form, it soothes the intolerable itching of *psoriasis* and *lichen*. Clysters of vinegar have been recommended for the destruction of *ascarides* of the rectum.

ADMINISTRATION.—As an internal medicine, good wine vinegar should always be preferred. The product of the distillation of wood sold for culinary purposes is both disagreeable and unwholesome. The *dose* of vinegar is from one to four fluidrachms; that of Diluted Acetic Acid (Acidum Aceticum Dilutum) is nearly the same. One or two fluidounces of vinegar may be given by enema. To form an acidulated drink, from one to two fluidounces of vinegar may be mixed with a quart of water. A lotion may be prepared by mixing two or three fluidounces of vinegar with five of water.

ACIDUM NITRICUM.—NITRIC ACID.

ACIDUM NITRICUM DILUTUM.—*Diluted Nitric Acid.*

SOURCES.—Nitric acid exists in nature combined with potassa, soda, lime, and magnesia. It is sometimes free in spring water, and, according to Liebig, in rain water after thunder-storms.

It is procured artificially by distilling in a retort a mixture composed of equal weights of nitrate of potassa and sulphuric acid. When perfectly pure, it is colourless, but it has usually a slight yellowish tinge, due to the presence of nitrous acid developed during the progress of distillation, or subsequently by the decomposing action of light. Its sp. gr. is 1.5. *Diluted nitric acid* consists of *one* part of nitric acid to nine of water. Its sp. gr. is 1.08.

HISTORY.—Some writers attribute its discovery to Raymond Lully, but others carry it back to the seventh century. It was first analyzed by Cavendish in 1785.

ACTION. *On Animals.*—In even its most concentrated form nitric acid acts much less energetically than sulphuric acid upon the animal functions and tissues, but the symptoms produced by the two acids

differ in little but degree. The most important distinctive character of nitric acid is that, when swallowed, it does not, like sulphuric acid, coagulate the blood. If injected into a vein, it has indeed this effect, but only partially. In one of Orfila's experiments the left ventricle of the heart contained two large gelatinous looking clots of a dusky-red color, surrounded by a small quantity of like colored serum, and the large bloodvessels of the thorax contained liquid blood.¹ Viborg injected a drachm of fuming nitric acid, with three drachms of water, into the jugular vein of two horses. Immediately afterwards they were lively and breathed quicker, and the pulse was more frequent. These symptoms were followed by signs of depression, which passed away in the course of two hours. At this time some blood was drawn; it coagulated readily, and had but little buffy coat.²

On Man.—The symptoms occasioned by concentrated nitric acid are almost identical in kind with those of sulphuric acid, since they mainly depend upon the destruction of the tissues to which the liquid is applied. But the caustic action of the former is much less rapid and profound than that of the latter. Another striking difference is the peculiar color of the integument stained by nitric acid. Although the stain is white at first, it soon becomes orange-yellow, and upon the mucous membranes brown, owing probably to the action of the alkali contained in the salivary and other secretions. The recent stain of iodine, which bears some resemblance to that of nitric acid, differs from it in being removable by caustic potash, whereas the other is permanent. The enamel of the teeth is rendered very white, and is partially destroyed by this acid. Administered internally, and in small doses, diluted nitric acid exerts at first a tonic action, increases the appetite, and augments the flow of urine. It generally produces a white coating on the tongue, and dryness of the mouth. Sometimes, after a few days' employment of it, the teeth begin to grow loose, and the gums to bleed. At the same time the flow of urine increases. Its longer employment occasions dyspepsia, colic, foul breath, headache, feverishness, debility, and constipation, or diarrhœa. A small pustular eruption sometimes appears upon the skin. Bateman, who gave the acid in a diluted form for hepatic derangement, found that it produced salivation, but neither fetor of the breath nor ulceration of the gums. But all of these symptoms existed in several of the cases reported by Prioleau.³ This salivation would appear not to depend upon the local action of the acid, if we may accept the statement of Richter, who found the same effect produced by nitric acid baths. According

¹ Toxicologie, i. 163.² WILMER, Wirkung, iii. 351.³ Vid. infra.

to Clarus, it is less refrigerant, and relieves the thirst less than sulphuric acid, and is less stimulating than hydrochloric acid.

USES. *As a Disinfectant.*—About the close of the last century Dr. Carmichael Smith drew general attention to the effects of nitric acid vapors in preventing or destroying the contagion, particularly of typhus, or jail-fever as it was commonly called. Its apparent efficacy in staying the advance of epidemics of this disease, induced the British Parliament to reward the proposer of the method with £5,000. Experiments were made with the nitrous fumigations, as they were termed, in various parts of Europe, and the verdict in their favor was nearly unanimous. Hospital wards, in which were patients suffering under typhus, dysentery, gangrene, and even yellow fever, were fumigated, and almost always with apparent advantage. In Seville, it was even alleged that in whatever house or ward this method was practised, no more persons died or fell sick. Dr. Smith directed the vapor to be prepared by mixing equal parts of sulphuric acid and saltpetre together in a saucer placed upon hot sand, and to be used for two hours morning and evening. However effectual it may have been in destroying contagion, the plan was found to have serious inconveniences. The vapors had a very irritating effect upon both patients and attendants, producing cough and an abundant secretion of mucus from the lungs and throat, and sometimes hæmoptysis or diarrhœa, besides filling the wards or chamber with a sour smell. It was undoubtedly useful, however, in correcting the foul odors of the sick, and perhaps, also, in neutralizing the infectious effluvia. It might still be resorted to as a convenient substitute for chlorine.

Internally.—In fevers of a malignant or typhoid type, it was prescribed by Hoffmann and others. Ferriar regarded it as almost a succedaneum for cinchona in typhus fever, and, although many have advocated its use, in this disease and in scarlet fever, its utility must be considered as very questionable.

The favorable reports by Hope,¹ of the effect of fuming nitric acid in the treatment of *cholera*, *dysentery*, and *diarrhœa*, obtained, at one time, quite an extensive popularity for the mixture he employed. But subsequent experience has not confirmed the opinion entertained of its efficacy.

Dr. Arnoldi, of Montreal, has proposed nitric acid as almost a specific remedy for *whooping-cough*, and his recommendations have been sustained by Drs. Gibb,² Witsell,³ Atcherly,⁴ and others. Under its use

¹ Edinb. Med. and Surg. Journ., xxvi. 35.

² A Treatise on Hooping-Cough, Lond., 1854.

³ Chast'n Med. Journ., xii. 84.

⁴ Times and Gaz., Feb. 1859, p. 210.

the violence of the paroxysms is said to be greatly mitigated, and the duration of the disease abridged by more than one-half. Arnoldi directed as much acid to be added to a tumblerful of very sweet water "as would bring it to the strength of pure lemon-juice," and this is stated as the quantity an adult should consume in three or four hours. For a child one year old, the dose is a dessert-spoonful of the mixture every hour. Dr. Gibb directs fifteen drachms of dilute nitric acid, in an eight-ounce mixture, of which two or three drachms are to be given every hour or two, which is more than half a drachm of the acid at each dose! Mr. Atcherly directs five minims every three hours for a child six months old, and gradually increases the dose to fifteen minims every second hour. The medicine is directed to be continued for some time after the cessation of the paroxysms, and in children who have teeth, a gargle composed of two drachms of carbonate of soda dissolved in eight ounces of water, should be used after each dose of the medicine.

Nitric acid was greatly extolled by Alyon in *syphilitic eruptions* of the skin, and subsequently by Beddoes and by Scott as a specific in venereal complaints. The last-named writer inferred from his observations that the action of the acid resembled that of mercury, and hence he recommended it in the treatment of syphilis. A large number of physicians in England, and on the continent of Europe, employed it in both primary and secondary syphilis, and in this country not less flattering statements were made of its efficacy by Prioleau.¹ He used it in primary as well as secondary syphilis, and with very satisfactory results. In almost every case it produced ptyalism, and in several swelling of the submaxillary glands. Hutchinson found it almost useless in primary syphilis, but a majority of cases of ulcers in the throat, eruptions on the skin, and periosteal swellings, were cured by its use.²

Ferriar³ did not estimate its effects so highly as many other physicians did. He thought its power limited to certain specific symptoms in the advanced stages, such as pains in the bones, and superficial ulcers.

These results, when attentively examined, do not afford sufficient ground for attributing an antisyphilitic virtue to the medicine. The cases in which it seems to have been most decidedly useful were those of chronic syphilitic ulcers of the gums, of general feebleness of function arising from a serofulous taint, and a morbid susceptibility to the

¹ CALDWELL'S Med. Theses, p. 81.

² Med. Museum, i. 433.

³ Med. Histories, p. 386 and 411.

influence of mercury. But in all of these respects, and in the two latter especially, iodide of potassium is of far greater efficacy.

Several cases of *diabetes mellitus* are reported as having been cured by this medicine, which also assuaged in a remarkable manner the characteristic thirst of the disease. In chronic derangement of the *liver* it was prescribed with advantage by Scott, who found it, however, less efficient than nitro-muriatic acid. A striking case of efficacy is presented by Ffirth;¹ it was one of chronic enlargement of the liver in a scorbutic subject, and the disease was contracted in India. The medicine produced ptyalism, and from this event the patient's improvement commenced. Bateman employed it successfully in *jaundice*, and Zägli reported more than fifty cases of cure, which he attributes to its influence. "In those ill-conditioned *scrofulous sores* which approach the nature of cancer," says Chapman,² "it has proved the most successful of all the remedies which I have tried. Not a few of the cases which had previously resisted the best external modes of treatment, I have cured by the free internal use of it."

Rayer states that he cured very obstinate cases of *impetigo* by means of nitric acid, of which he gave half a drachm in a pint of sweetened barley-water in the course of the day. When it deranged the stomach its administration was suspended for a few days, and tepid baths were prescribed. It very rarely happened that a cure was not effected in from four to six weeks.

Externally.—This acid has been employed to *blister the skin* when the use of cantharides or other vesicants proper would have involved too long a delay. But it is far less to be recommended than ammonia, both on account of the severe pain it causes, and of the intractable ulcer that may result from its use. The *bites* of *rabid animals*, *poisonous serpents* and *insects*, &c., have also been cauterized with nitric acid. It forms an excellent ingredient for gargles and washes in *secondary syphilitic sores* of the throat or nasal passages, and, when added to water so as slightly to acidulate it, is an efficient application for indolent as well as flabby or sloughing sores. Wedekind gave it internally to arrest *mercurial salivation*, but its local application by means of a mop, or, what is better, a fine brush, followed by the use of gargles containing about one drachm of the diluted acid to six ounces of water, usually succeeds in restoring a sound state of the mucous membrane of the gums. Thompson mentions having suspended mercurial salivation by its internal use. Lotions or foot-baths containing this acid have been found serviceable in *chilblains*, particularly after they have lost their

¹ Med. Museum, ii. 62.

² Therapeutics, ii. 519.

acute character. Dewees recommended warm baths feebly acidulated with this liquid for the *jaundice* of new-born children.

By applying it over indolent *peristoses* so as to produce a slight inflammation of the skin, Lallemand found that it caused these swellings to disappear. The strong acid can be used as a caustic in most of the cases enumerated under the head of sulphuric acid, and particularly to remove venereal and other *warts* and fleshy excrescences of all kinds. In none is it more effectual than in curing *condylomata* and *hæmorrhoids*. It is applied by means of a mop of lint fastened upon a wooden handle, care being taken to avoid touching the surrounding skin, which, indeed, had better be smeared with resin cerate. The method undoubtedly is very painful, particularly at the first application, but on the second it is less severe, and the acid is seldom required a third time.¹ In *caries* of the bones and in sloughing *phagedæna*, the strong acid has often been employed successfully to promote the separation of the dead tissues. In hospital gangrene it is peculiarly serviceable.

ADMINISTRATION.—The dose of the stronger acid is from five to twenty minims, and of the diluted acid from twenty-five to fifty minims, three or four times a day, in at least three fluidounces of a watery vehicle, and it should be taken through a tube. It should never be associated with salifiable bases, with the carbonates, acetates, &c., nor kept in metallic vessels.

CHLORINIUM.—CHLORINE.

AQUA CHLORINII.—*Chlorine Water*.

DESCRIPTION.—“*Chlorine* is an elementary gaseous fluid, of a greenish-yellow color, and characteristic and disagreeable smell and taste.” It may be obtained by decomposing chloride of sodium by means of diluted sulphuric acid and deutoxide of manganese. During the process, sulphate of soda and sulphate of the protoxide of manganese are generated, while chlorine is given off. *Chlorine water* is prepared by passing chlorine gas through distilled water, which absorbs nearly twice its volume of the gas. To prevent its decomposition, it should be kept in glass-stoppered bottles, made impervious to light by a black coating. Chlorine was discovered by Scheele in 1774.

Action on Vegetables and Animals.—Chlorine destroys most vegetable colors if moisture be present. Nysten introduced a small quantity

¹ W. COOKE, *Times and Gaz.*, Ap. 1853, p. 343. H. SMITH, *ibid.*, Aug. 1854, p. 184; Nov. 1855, pp. 526, 566; *Lancet*, Oct. 1858, p. 452.

of chlorine into the jugular vein of a dog of medium size. The animal gave some signs of pain. After five minutes' interval, a larger portion was injected; the dog howled violently, breathed laboriously and painfully, and died in three minutes afterwards. The heart was found distended with fluid blood.¹ The same experimenter, on another occasion, introduced a quantity of this gas into the pleural cavity of a dog. The animal became very restless, voided urine, and then fell upon his side stiff, and without signs of pain. He arose afterwards, but continued to whine. For three days he seemed to suffer greatly, and he was then killed. Both pleuræ were lined with false membrane, and contained bloody serum. Orfila found that, by introducing chlorine water into the stomach of dogs, inflammation and ulceration of the gastric mucous membrane were excited.² According to Nysten, pure chlorine gas, when breathed by animals, is not absorbed, but produces such rapid and violent inflammation of the bronchia as to prove fatal.

Wallace gives the following account of the effects of chlorine diluted with air and watery vapor upon the human skin.³ When a person is inclosed, except the head, in a box, and subjected to this agent at a temperature of 110° F., in the course of ten or twelve minutes he experiences, in various parts of the skin, sensations like those produced by the stings or bites of very small insects. They gradually extend to the greater part of the body, but cease upon the patient quitting the bath, and are succeeded for a short time by heat and itching. A more or less copious sweat accompanies this sensation, and is followed by an eruption of minute pustules upon the trunk and arms. If chlorine is applied to a more limited surface, the skin grows red, and if the application is continued, it excites severe pain and swelling, which, as well as the redness, augment, so that the integument acquires an erysipelatous aspect, and, for some time afterwards, feels as if it had been bruised. These symptoms are of several days' duration, and are succeeded by itching and desquamation of the cuticle. That chlorine is absorbed by the skin is proved by the characteristic taste which is perceived in the mouth after a hand or any part of the cutaneous surface is exposed to its action. When inhaled in a concentrated form, it acts as an irritant, exciting spasm of the glottis, and a sense of constriction of the chest and suffocation, or violent cough and hæmoptysis; but in a diluted state it produces a gentle sense of warmth in the air-passages, and increases the secretion of mucus. When habitually inhaled, it soon ceases to produce marked

¹ WIBMER, *Wirkung*, &c., ii. 107.

² *Toxicologie*, i. 113.

³ *Ibid.*

symptoms, and, indeed, is alleged to increase the appetite, but it occasions a loss of flesh, and yet is said not to shorten the lives of the workmen engaged in factories where it is employed. These workmen are subject to acidity of the stomach, which they are in the habit of correcting by the use of chalk. The above statement regarding its influence on the appetite is confirmed by Hallé, who asserts that chlorine water, when largely diluted, augments the appetite and strengthens the digestion. Nysten alleges that it acts as an astringent on the bowels, producing constipation, and bleaching the excrements.

USES. *As a Disinfectant.*—Hallé was the first, in 1785, to point out the disinfecting properties of chlorine. A few years later (1791), Fourcroy proposed it as a means of neutralizing the effluvia arising from the decomposition of animal matter in graveyards, &c., and of destroying infectious miasmata. Chaussier employed it as a disinfectant in the dissecting-room, and Cruikshank first adopted it, on a large scale, as a means of purifying the air of hospital wards at Woolwich in England. These examples did not, however, suffice to recommend the agent to general confidence until its properties were more fully illustrated by Guyton Morveau in 1803. About twelve years later, Thénard suggested the use of chlorine water instead of the gas, and it was employed to limit the ravages of an epidemic which then prevailed in Holland.¹

Not a few examples might be adduced in which the use of chlorine appeared to arrest the extension of infectious diseases. The most striking illustrations, however, are furnished by diseases of a strictly local origin, those which appear to have arisen and to have been sustained by effluvia from accumulations of animal or vegetable matter in a state of putrefaction. But even here the alleged power of chlorine is open to question. That it destroyed the offensive odors of the decaying masses is certain; but when it is recollected that these collections were usually at the same time removed in whole or in part, and that the neighborhood was subjected to a more or less complete system of purification by means of water, air, heat, &c., the part of the result remaining due to the action of chlorine is perhaps not very large. As regards epidemic diseases of atmospheric origin, such as cholera and yellow fever, it is certain that chlorine, in whatever manner employed, offers no obstacle to their diffusion. It is said that chlorine destroys the contagious property of the vaccine and the gonorrhœal virus,² but the statement needs confirmation. Chlorine water is a convenient agent for correcting the stench of alvine discharges

¹ MÉRAT et DE LENS, Dict. de Thérap., ii. 241.

² CLARUS, Arzneimittell., p. 248.

in the sick-room, the foul odor of the breath, of the offensive secretions of gangrenous and other sores, &c.

Fevers.—A great number of writers have testified to the virtues of ehlorinated water and the ehlorides in different forms of fever, but especially those of a typhoid or malignant type. It would seem to be indicated when the pulse is increased in frequency without being stronger than natural, or with an absolute loss of its force.¹ This is peculiarly the case in *petechial typhus*, during its middle stage; it is also a frequent incident of typhoid fever and the eruptive fevers, and is usually attended with a languid state of the capillary circulation, a dry, incrustated state of the mouth, fetid evacuations, and great debility. Its effects are stated to be a reduction of the heat of skin and frequency of pulse, followed by perspiration, subsidence of the cerebral symptoms, diminished fetor of the breath and stools, and abatement of the tympanitis. The medicine was extensively used by military surgeons during the epidemics of typhus which ravaged the allied armies in the European campaigns of 1813–14, and many hospital physicians, attracted by its alleged success at this period, introduced it subsequently into civil practice. In certain cases, and in certain epidemics even, its effects appear to have been like those above described, but they were far from being generally so. In most instances it seemed to influence the course of the disease injuriously, if at all, and to augment the dryness of the tongue and skin. Hufeland, Mareus, Clemens, and others, found it useful as a means of appeasing the irregular tumult of the circulation, and promoting a crisis in scarlatina; and D'Alquen² went so far as to say that "it is here almost a specific like quinine in intermittent fever." This writer prescribed it especially in the anginose variety with copious eruption, burning skin, delirium, and convulsions. He appears, however, to have insisted very little on its internal administration. As a *lotion* during the hot stage of *typhus*, and indeed of other fevers, it has been thought to be effectual in giving softness to the integument and lowering its temperature. The author last quoted alleges it to be peculiarly useful in *scarlatina*. He directed the skin to be washed with a sponge saturated with equal parts of lukewarm water and ehlorinated water every two or three hours until the approach of the crisis. If it produces chilliness, the application should be suspended. The crisis, as described by this writer, is denoted by a violent degree of fever and delirium, and even convulsions, which symptoms last for two or three hours, and are succeeded by a rapid declension of the fever, &c. This sketch is hardly drawn from nature, and were it

¹ SACHS und DULK, Handwört., &c., ii. 195.

² Lancet, Jan. 1841, p. 617.

even so, the decline of the febrile symptoms cannot be attributed to the chlorine employed so much as to the sponging with water, for this alone, as every physician knows, will sometimes bring about a resolution of the fever, and that without the intervention of any such "crisis" as is here attributed to the action of chlorine. Chlorinated water has been highly recommended as a lotion in smallpox, during the maturative and subsequent stages. A weak solution, at a proper temperature, is perhaps useful as a means of correcting the fetid exhalations of the skin.

Diseases of the Lungs.—It was imagined at one time that in chlorine would be found a specific for *pulmonary consumption*. Workmen disposed to the disease were thought to be benefited by the exhalations in factories where chlorine was employed. Patients affected with phthisis were lodged in apartments where at regular intervals, or constantly in some cases, this gas was allowed to mingle with the atmosphere. In one of the reports made of the results of this treatment it was said "that all of the patients were relieved, and experienced a remarkable degree of comfort; the breathing became freer, the sputa scantier, and there was neither a sense of heat in the chest, fever, nor hæmoptysis, and some of the cases got well.¹ These striking results were published by M. Gannal, and were more or less confirmed by other physicians at the time; but the method speedily lost the degree of confidence it had acquired, and fell into complete disuse. In a memoir presented to the Royal Academy of Medicine² by M. Jolly, the author states, as his conclusion from sufficient experience, that the use of chlorine inhalations, or an atmosphere of the gas, is wholly useless in consumption of the lungs, and that in many cases it even acted mischievously by increasing the cough, the oppression, and the fever. The remedy is nevertheless endowed with some power of palliating the cough and moderating the expectoration in certain chronic diseases of the lungs. Pereira, indeed, declares his belief, with Albers, that in ulceration of the lungs it occasionally may be of essential service. But what ulceration is meant, if not tubercular, does not appear. *Chronic catarrh* seems to have been favorably modified by chlorine inhalations, but as remedies for this disease they seem to be in every respect inferior to terebinthinate medicines. *Whooping-cough* has in some cases been cured by the same means.

Gaseous chlorine, either pure or mixed with air, in the form of a bath, was recommended by Wallace, Zeise, Julius, and other writers, for the cure of *jaundice*, *biliary calculi*, and *dropsies*, dependent upon

¹ MÉRAT et DE LENS, Dict. de Thérap., ii. 247.

² Bull. de l'Acad., iii. 272.

functional disorder of the liver. The first mentioned writer, however, employed the vapor at a temperature of 150° F., and this fact, which seems to have been overlooked in estimating the value of his plan of treatment, is a sufficient explanation of its effects, without attributing much if any part of them to the chlorine itself.

Chlorinated water and chlorinated oil have been thought useful in some *scaly eruptions* of the skin and in *scabies*. The former has also been recommended for the cure of *chilblains*. This preparation has also the valuable property of destroying the *fetid smell* of cancerous and other sores, and otherwise improving their condition. In *putrid sore throat* it is a very useful ingredient of washes and gargles. Fumigations of chlorine should always be used in hospital wards and the chambers of the sick when the air becomes offensive by the patients' exhalations or discharges.

Animal Poisons.—Chlorinated water has at different times been vaunted as a preventive of the infection of *syphilis*, of *rabies canina*, of the *plague*, of the poison of *venomous insects*, &c. As a protection against hydrophobia it seems to occupy similar ground with many vaunted but now neglected specifics. Many persons, it is true, who had been bitten by rabid animals, escaped madness after their wounds had been washed with chlorinated water, or some other preparation of chlorine. But this fact is stripped of all its value when it is considered that the same result frequently takes place when no treatment whatever is applied to the bitten parts; that, in fact, the teeth of the animal have been wiped of their poisonous slaver by penetrating the clothing of the person attacked. It is, however, alleged that chlorinated water, given internally, has actually cured fully-developed hydrophobia. But the cases upon which the assertion rests are too few and too obscure to shake conclusions that have been arrived at by means of a large mass of well-authenticated facts. In regard to the power of this agent to prevent syphilitic contagion very similar objections may be made. Impure coition by no means necessarily communicates the disease, and there is therefore no more reason to believe that chlorine more than simple water can avert its consequences. The same remark may be made respecting the ability of chlorine to destroy the supposed contagion of the plague in clothing, and other fomites. Its power seems to be neither greater nor less than that of the ordinary means of purifying infected articles.

ADMINISTRATION AND DOSE.—The dose of chlorine water is variously stated by different authors; but the United States and London Dispensatories direct from *one* to *four fluidrachms* properly diluted. It may be given with four, five, or six parts of distilled water, sweetened.

It is decomposed by all decoctions and infusions, except decoction of jalap (D'Alquen). For inhalation *ten to thirty* drops of ehlorine water should be mixed with six or eight ounces of water, and inhaled from a proper apparatus several times a day.

ANTIDOTES.—Albumen is the best antidote to poisoning by chlorine. That substance may be given in the form of milk, the white of egg, veal broth, &c., and should be taken in large quantities, so as to encourage vomiting. In the absence of albuminous articles, flour, or even the alkaline earths, may be tried. Inflammation of the stomach is to be combated with emollients.

LIQUOR SODÆ CHLORINATÆ.—SOLUTION OF CHLORINATED SODA.

PREPARATION.—Solution of chlorinated soda is obtained by decomposing a solution of carbonate of soda by one of chlorinated lime. A reciprocal interchange of elements takes place, and, carbonate of lime being thrown down, chlorinated soda remains in solution. It is a colorless, transparent liquid, possessing an alkaline reaction, a taste at once alkaline and saline, and the odor of ehlorine. It destroys the color of vegetable substances; by exposure to the air it gives off chlorine, and is rapidly converted into carbonate of soda.

HISTORY.—In 1826, M. Labarraque published his formulæ for preparing the chlorides, and soon afterwards introduced the chloride of soda into medical practice. It has hence been generally known as *Labarraque's liquid*, or (from the purposes for which it was applied) *disinfecting agent*.

ACTION. *On Animals*.—The washing liquid used in France under the name of Eau de Javelle, is a chloride, sometimes of soda and sometimes of potassa. In both cases the effects are said to be the same. According to Ségalas,¹ concentrated chloride of soda is irritating and caustic, and, if absorbed, manifestly alters the blood. This author, and Christison, both state that it gives rise to tetanic spasms. When administered to dogs by Orfila, it produced violent attempts to vomit, and copious liquid stools, followed by agitation, and then by exhaustion and death. The stomach and intestines of the animals were found to be inflamed.²

On Man.—Mérat and De Lens saw a girl of sixteen who had drunk a glass of the washing liquid. The chief symptom was general rigidity, which yielded, however, to demulcent drinks. The symp-

¹ MÉRAT and DE LENS, Dict. de Thérap., ii. 256.

² Toxicologie, i. 294.

toms of a case of poisoning by this preparation are related by Dévergie, but they seem to have been caused in part by strong mental disturbance. They were as follows: Convulsions, loss of consciousness, extreme pain in the pharynx and œsophagus, with difficult deglutition, tenderness of the epigastrium, but neither vomiting nor diarrhœa. Other cases reported by Orfila and by Taylor, presented essentially the same phenomena. Gendrin saw hæmorrhoids produced by this medicine, in a person who was taking this medicine for the relief of goitre. It is said to promote menstruation. A dessert-spoonful of solution of chlorinated soda was given by mistake to an infant of one year old. It was scarcely swallowed before the exhaled chlorine produced signs of suffocation. The fauces were speedily cleansed, but the child cried and moaned with a hoarse voice, rolled about incessantly, and coughed violently. The skin grew pale and damp, the pulse was small and scarcely perceptible, the abdomen indolent, the buccal mucous membrane was whitish, and the breath smelled of chlorine. Subsequently the abdomen became tender upon pressure, and a copious watery discharge, which smelled of chlorine, took place from the bowels.¹

"In moderate or small doses," says Pereira, "chloride of soda has been denominated stimulant, tonic, astringent, antiseptic, and febrifuge." But, as this author justly observes, these terms give no real explanation of the nature of those organic changes whereby we obtain such benefit from the employment of the medicine in various diseases. He states that he has seen moisture of the skin follow its use in fever; that increased secretion of urine is a common effect of it; that in fevers it improves the qualities of the evacuations; and that it causes chronic glandular enlargements and chronic mucous discharges to disappear. No doubt this author, and several others who make the same suggestion, are right in attributing these effects to the soda rather than to the chlorine which the compound contains.

The antiseptic qualities of chlorinated soda, depending as they do upon the chlorine which it contains, are closely analogous to those of chlorinated water, and of chloride of lime, under which heads this branch of the subject will be found more fully treated.

REMEDIAL USES. *Typhoid fever*.—Chlorinated soda was at one time very much used in the treatment of typhoid fever, both internally and externally, in lotions and in baths. Chomel² subjected this method to a very careful and thorough trial. He prescribed the chloride in a sweetened solution of gum Arabic, containing from one grain or one

¹ DIERBACH, *Neuste Entdeck.*, iii. 914.

² *Compend. de Méd. Prat.*, viii. 258.

grain and a half to the ounce. Of this solution his patients generally took from fifty to ninety ounces in the twenty-four hours. Injections of it were administered night and morning; the surface of the body was freely washed with an aqueous solution of the chloride several times a day, and poultices moistened with this latter were applied to the abdomen; the bedclothing was sprinkled with it, and vessels containing it were placed under the bed. The treatment was supposed at first to exercise a salutary influence, but it was soon discovered to deserve no higher confidence than other reputed specifics for the disease, and it was therefore abandoned altogether. Other Parisian authorities, among whom may be mentioned Bouillaud, Reveillé-Parise, and Andral, arrived at like results, and also relinquished the use of the medicine. In other countries experience led to similar conclusions. In a kindred disease, *typhus* fever, one of the most eminent authorities, Dr. Graves, seems at one time to have thought this medicine valuable as a means of dissipating the torpor of the system and the want of tone which are so apt to be present during the decline of the febrile stage of the disorder.¹ But in his later writings this author does not so much as refer to the use of the chlorides in fever.²

For *intermittent fever* Lalesque,³ Châtillon, and Munaret,⁴ asserted the chlorinated solution of soda to be as certain a remedy as quinia itself, while it possessed the advantage of leaving no bad consequences behind it. Gouzée, too, without however going to such an extravagant length, stated it to be neither an irritant nor otherwise injurious, but positively curative in recent and mild cases of the disease.⁵ He thought it advantageous in enlargement of the spleen. It would be difficult now to find a solid foundation for such opinions; they are to be ranked with those which at one time or another have ascribed an antiperiodic virtue to almost every medicinal and even non-medicinal substance. Intermittent fever is often cured by causes which influence the imagination, and this doubtless should be ranked among them.

Ulcers.—A great many writers have recommended the solution of chlorinated soda as a wash for unhealthy ulcers, particularly those of an irregular surface, with sanious secretion, and for ulcers attacked with gangrene. Ulcers of the gums and of other soft parts within the mouth and fauces are very apt to assume these characters in persons of a cachectic constitution, and particularly in consequence of a mercurial salivation. In fact whenever a gangrenous tendency betrays itself, the chloride of soda is useful as well for correcting the offen-

¹ DIERBACH, op. cit., iii. 916.

² Clinical Medicine. ³ *Révue Méd.*, 1835.

⁴ *Gaz. Méd. de Paris*, 1835, op. 638.

⁵ DIERBACH, op. cit., iii. 918.

sive odor, which it does most effectually, as for stimulating the sound tissues to throw off the dead portions. The strength of the solution must, however, be carefully adjusted to the sensibility of the part. In chronic inflammation of the mucous membrane of the ears, mouth, urethra, vulva, uterus, &c., with a sanious or otherwise unhealthy discharge, a weak solution of this preparation is often of great utility.¹ Mixed with honey and water, it forms a valuable wash for aphthæ of the mouth. In certain acute inflammations attended with an acrid secretion, such as that of the fauces and nasal passages in anginose and in malignant scarlatina, injections of this fluid are of material advantage in preventing local ulceration and the diarrhoea to which the foul matter is apt to give rise when it is swallowed.

As an application to ulcers, this liquid was much praised by Lisfranc.² He held it to be resolute, sedative, and healing in its influence. He rejected its use when the affected part was indolent, upon the ground that under these circumstances it hindered the vital processes essential to cicatrization; he objected to it equally when the local inflammation was excessive, because it augmented this latter. The appropriate period for its use, according to this surgeon, is when granulations are well developed and a cicatrix begins to form. In burns of the first and second degree, Lisfranc prescribed chloride of soda for the sake of its resolvent and sedative action, and in those of a severer grade he taught that they allay inflammation at first, and subsequently favor the separation of sloughs and promote healing. These explanations, it will be perceived, do not perfectly harmonize with one another. It would seem that the principles upon which the solution ought to be applied are not well settled. The mode of application recommended by Lisfranc is the following. The affected part is, first, to be covered with a cribriform compress spread with cerate, over which a thick pledget of lint soaked in chloride of soda is applied. The solution ought to be strong enough to excite a moderate degree of heat and itching, and should be frequently renewed. Any phlyctenæ that exist upon the skin should first be punctured. Although this method of treatment has distinguished recommendations in its favor, and is certainly not wanting in usefulness, its advocates seem to have attributed results to the chlorine in the solution employed which were certainly quite as justly due to the associated alkali or even to the water of the dressing alone.

Godier asserted the usefulness of chlorinated soda in *scrofula*, both when taken internally and when applied in a salve to enlarged glands.

¹ GUIBOUT, Bull. de l'Acad., iii. 273.

² Bull. de Thérap., xv. 39, and xvi. 252.

This medicine has also been used in a great variety of *skin diseases*, and with less reference, it would seem, to their systematic form than to the vital state of the skin. When the eruption remains stationary or tends to grow worse, owing to debility of the skin itself, the stimulant agency of this preparation of soda has been found useful, but less so, it is believed, than those of the carbonate. In *smallpox*, Eisenmann recommended lotions with chlorinated water. He averred that they rendered the eruption milder, yet favored its development, and at the same time prevented the formation of hard scabs and of cicatrices.¹

In *poisoning* by sulphuretted hydrogen, the fumes of ehlorine derived from this liquid may be used advantageously as an antidote, but it is less appropriate than chloride of lime.

ADMINISTRATION AND DOSE.—“The dose of the officinal solution of chloride of soda is from thirty drops to a teaspoonful, given in a cupful of water or mild aqueous liquid, and repeated every two or three hours.” When used as a *gargle*, it should be diluted with eight or ten parts of water. As an *injection* into the vagina, uterus, or bladder, and as a *lotion* for burns, excoriations, and cutaneous eruptions, a solution in eight or ten parts of water is appropriate. A stronger solution may be directed in the treatment of gangrenous sores. Pereira states that in some sloughing ulcers he has used the officinal liquid mixed with its own volume of water, but that when first applied it should be much more largely diluted, as with five or six parts of water.

CALX CHLORINATA.—CHLORINATED LIME.

DESCRIPTION.—Chlorinated lime, often called chloride of lime, is obtained by passing chlorine over lime until saturation is effected. It is not a combination of atomic equivalents of lime and chlorine, but a mixture, in various proportions, of subehloride of lime, chloride of caleium, and water.

Chlorinated lime is a loose, grayish-white powder. It has an acrid, bitter, and somewhat caustic taste, and a faint smell of chlorine, and is readily soluble in water. It possesses powerful bleaching qualities. “Exposed to the air, it attracts carbonic acid, evolves chlorine, and is thereby converted into a mixture of carbonate of lime and chloride of calcium, the latter of which deliquesces.” (*Pereira*.) For this reason, it should be preserved in glass-stoppered bottles. It is chemically in-

¹ See also GABB, Am. Journ. of Med. Sci., July, 1857, p. 232.

compatible with the mineral acids, with carbonic acid, and with the alkaline carbonates. Guibourt found¹ that when equal quantities of powdered sugar and chlorinated lime are triturated together, and then inclosed in a well-stoppered bottle, along with a small proportion of water, caloric is rapidly disengaged, and in a few minutes the mixture explodes. This mixture possesses no decolorizing properties, and is decidedly acid in its reaction. Hunoux Desfontenelles observed that in preparing pills of chlorinated lime with extract of opium and honey, the compound took fire spontaneously, and was consumed. A similar reaction obtains between this substance and liquorice, and also althea root. It is said to neutralize the narcotic principle of opium.²

HISTORY.—The chlorinated lime was first described in France, by Décroizelles,³ but it only became known through Mr. Tennant, of Glasgow, who, in 1798, took out a patent for its manufacture as a bleaching powder. In 1803, Guyton Morveau drew attention to it as a prophylactic against contagion, and Dupuytren and Barruel afterwards employed it to disinfect a privy-well, which contained sulphohydrate of ammonia. In 1811, Masuyer, of Strasburg, published the results of his experiments with it for purifying hospital wards, dissecting-rooms, &c.; but it was not until the appearance of Labarraque's essay, in 1822, on the disinfectant properties of the chlorides, that this preparation was extensively employed as a medicine.

ACTION.—The *modus operandi* of chlorinated lime upon the animal economy is not settled. It resembles, however, that of chlorine, with a superadded causticity derived from the lime in its composition. In moderate doses it sometimes appears to act as an irritant of the stomach and bowels; and if the quantity taken be large, it produces heat in the epigastrium, nausea, vomiting, and diarrhœa. According to Richter⁴ it is an excitant of the lymphatic system, the mucous membranes, the several secernent organs, and especially the kidneys and liver, and is therefore an appropriate remedy for obstructions and indurations of glandular structures. Jolly observed⁵ that the chloride of lime, as well as of soda, when used as a gargle or mouth-wash, removes acid, bitter, saline, or metallic tastes from the mouth, and that for several days together.

Externally its operation is that of an active irritant, and sometimes it is even moderately caustic. When applied to suppurating surfaces it is a powerful desiccant, owing, probably, as Pereira suggests, to the

¹ Bull. de l'Acad., ii. 276.

³ MÉRAT and DE LENS, op. cit.

⁵ Bull. de l'Acad., iii. 277.

² STRUMPF, op. cit., ii. 617.

⁴ Ausführlich. Arzneimittel., iv. 305.

uncombined lime in its composition. Its peculiar advantage is shown in its preventing or suspending gangrenous ulceration. Heiberg observed that, like other stimulants, it acted as an irritant or as a wholesome tonic, according to the strength of the solution of it employed.

REMEDIAL EMPLOYMENT. Fevers.—Reid and others used chlorinated lime in the epidemic typhus of Ireland, and ascribed to it the faculty of rendering the tongue moist and clean, appeasing the delirium, and reviving the cutaneous functions. Graafe prescribed it dissolved in an infusion of valerian,¹ with apparent advantage in typhoid fever. Edwards regarded it as improving the secretions and sustaining the strength in this disease.² It was extensively employed for its therapeutical effects, as well as for its disinfectant qualities, in the oriental plague. Grimod alleged that, in an epidemic of *smallpox*, children were preserved from the contagion by being washed with a weak solution of this compound. Gubian, of Lyons, also employed it to prevent pitting after variola. But neither of these methods has stood the test of experience.

Inflammations.—Guthrie and others made use of a solution of chlorinated lime, with excellent results, in purulent ophthalmia, by dropping it into the eye, or applying it by means of a camel's hair pencil. The strength of the solution varied from one scruple to several drachms in an ounce of water.³ But these authorities do not appear to have omitted any of the ordinary sedative, revulsive, or depletory measures which are usually relied on for curing the disease. Varlez also employed it in the purulent ophthalmia both of adults and of infants. For the latter a solution of ten grains to the ounce was used. By its means, he asserts,⁴ that he succeeded, after all other means had failed, in arresting an epidemic of purulent ophthalmia which was ravaging the French army in the Low Countries. He instilled the freshly-made collyrium between the lids of the affected eyes from three to ten times every day. Haase, of Dresden, made use of it as a prophylactic against the disease in the infants' hospital of that city, as well as for curing the affection in them and in adults.⁵ Deconde, a Belgian military surgeon, testifies to the same effect,⁶ and Pereira found it a successful application. Eberle employed it in several cases with great advantage.⁷ Ricord ascribed the speedy cure of a case of *frostbite* of the fingers to the use of a dressing of charpie saturated with a solution of chlorinated lime;⁸ and

¹ GIACOMINI, *Mat. Med.*, 469.

³ RICHTER, *op. cit.*, iv. 313.

⁵ DIERBACH, *Neuste Entdeck.*, i. 416.

⁷ *Therapeutics*, p. 289.

² STRUMPF, *loc. sup. cit.*

⁴ MÉRAT and DE LENS, *Dict. cit.*

⁶ *Ibid.*, iii. 903.

⁸ RICHTER, *op. cit.*, iv. 312.

Lisfranc and Graafe employed it successfully for the same affection.¹ The last named writer, Caussade,² and Roussif used it both internally and as an injection for the cure of *gonorrhœa*, and, as they report, successfully; but the method does not seem to have been frequently adopted. It is said at first to increase the flow of urine and to produce some irritation of the urethra, but these symptoms, and the discharge with them, soon decline. In *hospital gangrene* this remedy is very effectual, at least in the milder cases. Sanson made use of it in *ulceration* of the *moult*, with caries of the hard palate; Lagneau in *softening* and gangrene of the *gums*; Kopp, of Hanau, in *scorbutic* gangrene of the mouth; Angelot, of Besançon, Delpech, Percy, Travers, Roche, Cloquet, and many others, might be cited to the same effect. Jolly states³ that he used the dry chloride of lime with marked success for ulceration of the gums, and gangrenous pustule (*ulcus noma*), in children, and Berndt also employed it with great advantage in the same affection. The solution of chlorinated lime forms a very excellent wash for the Schneiderian membrane when it becomes inflamed and ulcerated in scarlatina, and also in chronic inflammation of this tissue. *Indolent ulcers* were successfully treated by Lisfranc with this solution, which was applied to them in the manner already described for chloride of soda. It is stated to have induced the healing of ulcers which had resisted other modes of treatment for eight or ten months. In a case of fistulous ulcer, Ricord effected a cure by its means. Heiberg extolled its virtues in cases like those mentioned, and also in *burns* and in *syphilitic* and *cancerous* sores. He regarded it as possessing a decidedly anodyne quality, especially in open cancer.

Diseases of the Skin.—Preparations containing chlorinated lime have been largely used in numerous cutaneous diseases. Kopp recommended them in scaly as well as vesicular eruptions,⁴ and Wenzel reported a very high degree of success in the treatment of *tinea capitis* by means of an ointment made with this compound. But in the Berlin Hospital it was found, after a four years' trial, that a solution of chlorinated lime was incompetent to cure the disease. It cleansed the head and moderated the inflammation of the scalp, but did not reach the alteration of the hair-bulbs, which properly constitutes the malady. Numerous writers have testified to its efficacy in the treatment of *itch*. For this purpose Kopp applied a solution of from one to three ounces in a pint of water three or four times a day. Fontanelli made extensive use of it in public and private practice. He prescribed a

¹ DIERBACH, i. 414.

² Ibid., p. 418.

³ Bull. de l'Acad. de Méd., iii. 274.

⁴ RICHTER, op. cit., iv. 308.

general warm bath every third day, and usually completed the cure within a week. Michaëlsen¹ found similar effects from the remedy, and gave the preference to it over sulphur because it is less offensive. Derheim alleged that he cured the itch in from six to ten days, by means of a lotion of chlorinated lime.² Schönlein and Hôpital employed a liniment composed of chloride of lime and black soap, and state that it was successful in the most inveterate cases of the disease. Christison says that he used this remedy with the best effects, and that since he first employed it he never had occasion to use any other remedy. He directed a solution, containing between a fortieth and a sixtieth of the chloride, to be applied five or six times a day, or continuously, with wet cloths, and found that it allayed the itching in the course of twenty-four hours, and generally accomplished a cure in eight days.³

It is not, however, to be concealed that other physicians have not only found the remedy objectionable on account of its irritative action, but some even, like Ebermaier,⁴ deny that it is curative at all. The truth appears to be that it is an effectual but not always an eligible remedy. It speedily irritates the delicate skin of females, and produces erosions or else a vesicular or pustular eruption. It is more advantageous when the derm is dense and hard.

Diseases of the Lungs.—Evidence might be found in the medical records of the use of chlorinated lime in *phthisis*; but after an examination of the data, it seems perfectly evident that the medicine has no other influence on this disease than to control to some extent the pulmonary secretions. In *chronic bronchitis*, with copious purulent expectoration of a fetid character, it has certainly been serviceable. In a case of thoracic fistula, communicating with the lung and discharging offensive pus, Eisenmann administered the remedy internally, and injected also a weak solution of it into the fistulous opening. It corrected the fetor of the breath, gradually diminished the discharge, and ultimately contributed to a perfect cure.⁵ In a case of acute inflammation of the lung, attended with fetid breath and sputa, hectic fever, &c., Drs. Graves and Stokes administered chloride of lime associated with opium. A very rapid amendment followed, and the fetor of the expectoration disappeared in the course of a few days. When the medicine was suspended, the discharge became again offensive, and was again corrected by the return to the use of the remedy.⁶ Dr. Popham, also of Ireland, treated a similar case successfully with this medicine and general stimulants.⁷

¹ DIERBACH, *op. cit.*, iii. 905.

² MÉRAT and DE LENS, *Dict. cit.*

³ *Dispensatory* (Am. ed.), p. 302.

⁴ DIERBACH, *op. cit.*, iii. 906.

⁵ *Ibid.*, 908.

⁶ *Am. Journ. of the Med. Sci.*, viii. 239.

⁷ BELL'S *Bull. of Med. Sci.*, i. 374.

Scrofula.—Cima employed this remedy successfully in scrofulous swelling of the *glands*. He directed from one scruple to one scruple and a half of it to be dissolved in six ounces of distilled aromatic water, of which a tablespoonful was given every two or three hours. It occasioned slight colicky pains, warmth in the stomach, and sometimes diarrhœa. After the use of the remedy for several months, the indurated glands became smaller, and the functions of the lymphatic system were re-established. He also prescribed an ointment composed of from one to three scruples of the chloride to an ounce of butter, with remarkable success, for scrofulous tumors of the cervical and inguinal glands and of the hands and feet, which had resisted mercurial frictions. The tumors at first became red, then itched severely, and at last grew softer and smaller.¹

Chlorinated Lime as a Disinfectant.—About the year 1825, Labarraque, Payen, Chevallier, Gay Lussac, and many other writers, drew general attention to the power of chlorine to prevent or suspend the decomposition of animal matter, and to neutralize the offensive or pernicious odors resulting from this process. The way in which chlorinated lime acts is, according to Dr. Bache, exclusively by its chlorine,² which, being loosely combined, is disengaged by the slightest affinities. All acids, says this writer, even the carbonic, liberate it; and as this acid is a product of animal and vegetable decomposition, noxious effluvia furnish the means to a certain extent of their own disinfection by the chloride. It has been employed for the preservation of bodies, in judicial investigations, by wrapping them in cloths wet with a solution of the compound, as well as for neutralizing the odor of decomposition after this process had commenced. Subsequently it was used to disinfect workshops, ships in which disease had prevailed, prisons, lazarettoes, hospitals, dissecting-rooms, theatres, sick-chambers, fomites of all kinds, markets, slaughter-houses, mines, privies, water-closets, sewers, wells, cesspools, stables, styes, and, in a word, all places rendered offensive and unwholesome by the putrefaction of animal or vegetable matter. Its faculty of neutralizing foul smells led to a belief that it was capable of counteracting diseases which the sources of such smells appeared to generate. The plague, cholera, yellow fever, small-pox, and other diseases which occur more or less epidemically, were made the subjects of numerous experiments, and the opinion was at one time entertained that fomites supposed to be vehicles for such diseases are purged of their infection by being subjected to the action

¹ RICHTER, op. cit., iv. 305 and 311.

² U. S. Dispensatory.

of chlorine, and especially of chlorinated lime.¹ It was very common for persons living within the limits of an epidemic to carry little bags containing this substance, which they snuffed from time to time, to neutralize the poison they might have inspired. Articles of furniture, whatever served for communication amongst men, ordinary food, even the healthy body itself, were deemed impure until duly washed or otherwise imbued with this preparation. In cities ravaged by the pestilence, persons were to be found who remained constantly in the same apartment, timidly breathing the exhalations of a vessel of chlorinated lime, in preference to the pure and open air. It is related that, during an epidemic of cholera in Moscow, the disease destroyed many of those very persons who had resolved to draw no breath that was not impregnated with the fumes of chlorine.² The uselessness of this agent as a prophylactic was attested by thousands of witnesses, many of whom did not hesitate to affirm that it increased rather than diminished the dangers of infection. Nor were other precautions a whit more effectual unless accompanied by attention to personal and domestic cleanliness, prudence in diet and exercise, and a cheerful disposition. The addition of chloride of lime to the number of these prophylactics became almost a matter of indifference.

In many diseases attended with offensive effluvia, chloride of lime is extremely useful both for correcting this symptom and for improving the condition of parts which give rise to it. A solution of the compound was found by Deslandes of great utility in a case of *retained placenta* which became putrid in the uterus. It was applied by injection, and appeared to suspend the disorganizing process as well as to correct the stench of the discharges. A solution of an ounce of the chloride in a pint of water was directed. Regnard employed a similar wash to correct the *foul breath* arising from carious teeth, and Deschamp used lozenges containing the chloride for the same purpose; Labarraque injected a solution of it into the vagina and uterus, to

¹ It is far from being demonstrated that any of these diseases, except smallpox, can be communicated by so indirect a channel. It cannot be denied that many who wore the clothing of the victims of pestilential disease, did themselves contract it, but it is far from certain that the infection was communicated by means of these fomites. When, therefore, the latter, after having been subjected to the action of chlorine, failed to impart the disease, the disinfecting power of the agent was by no means proved. Had it been shown that certain articles of clothing had really, in the first instance, been sources of infection, and that after having been subjected to the action of chlorine they had lost their infectious quality, the disinfecting powers of chlorine would have been at least probable; but in the absence of such a test, they may reasonably be questioned.

² RICHTER, *op. cit.*, suppl. bd., p. 529.

neutralize the fetid discharge in *cancer* of these organs; in gangrene of the lungs, it has been used to counteract the like symptom as well as to arrest the disorganizing process.¹ The late Prof. Horner treated successfully an aggravated case of *ozæna* by its means, and reported several others as in process of cure under its use.² The late Dr. Awl, of Ohio, furnished an interesting example of the same result,³ and Koechling another in which the disease supervened on suppression of transpiration from the feet.⁴ It may be applied with advantage to correct *foul breath* produced by the gaseous secretion of the mucous crypts of the fauces, by decayed food between the teeth, or by the use of tobacco. It is also useful in correcting the *acid secretion* of the salivary and mucous glands of the mouth, in moderating mercurial *salivation* and correcting its factor, as well as healing the ulcers which attend it, in preventing the formation of *tartar* upon the teeth, and in arresting the progress of *caries* in them, while it does no injury to the enamel. It is also a useful palliative for the offensive odor which the *feet* and other parts of certain persons exhale.

Poisoning by Hydrosulphuric Acid, &c.—Chloride of lime decomposes hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid, and may therefore be used as an antidote for these poisons. Labarraque restored a person who had been rendered insensible by the effluvia of a privy which he was engaged in cleansing, by holding a cloth wet with a solution of chloride of lime before his mouth and nostrils. Vinegar, ether, &c., had already been used without effect.⁵ It was by breathing air impregnated with the gas arising from chlorinated lime, that the late Mr. Roberts was enabled to traverse with safety the sewer of the Bastille, which had not been cleansed for thirty-seven years, and which was impregnated with hydrosulphuric acid. If a person be required to enter a place suspected of containing this gas, a handkerchief moistened with a solution of chlorinated lime should be applied to the mouth and nostrils, so that the inspired air may be purified before it passes into the lungs.⁶

ADMINISTRATION AND DOSE.—The dose of chloride of lime is from one to five or six grains in solution. From ten to sixty grains may be administered in the twenty-four hours, dissolved in from four to eight ounces of water and then decanted and filtered. If the statements of M. Jolly, above quoted, are correct, chloride of lime should

¹ RICHTER, op. cit., iv. 312.

³ Ibid., xi. 543.

⁵ RICHTER, op. cit., iv. 308.

² Am. Journ. of Med. Sci., vi. 265.

⁴ STRUMPF, Handbuch, ii. 626.

⁶ PEREIRA, Mat. Med., i. 582.

not enter into mixtures that contain sugar, lest a disengagement of the chlorine take place. As a wash for the mouth and other cavities lined by a mucous membrane, Christison recommends one part of the chloride to one hundred of water. For *external* use, the most energetic form in which the remedy can be applied, is that of a semi-fluid paste; the feeblest, to have any effect at all, is in the proportion of one drachm of the chloride to eight ounces of water. From one to four drachms in a pint of water forms a solution of medium strength. As an application to dry atonic ulcers, an *ointment*, composed of equal proportions of chlorine and lard may be employed; but for less indolent parts, such as scrofulous glands, the proportion of a drachm to the ounce is more eligible.

ACIDUM MURIATICUM.—MURIATIC ACID.

NATURAL SOURCES.—Muriatic or hydrochloric acid is found in the springs and streams of certain volcanic regions. According to Chevreuil, it exists in the sap of *Isatis Tinctoria*. It occurs in the mineral kingdom abundantly in combination with alkalies, earths, and metals, but most of all in muriate of soda (chloride of sodium), or common salt. In the animal kingdom it is believed to form a principal constituent of the gastric juice, and thereby to act as the chief solvent of fibrin, albumen, &c.

PREPARATION AND PROPERTIES.—It is obtained by the reaction of sulphuric acid with common salt. The products of this reaction are sulphate of soda and muriatic acid. The latter, as thus obtained, is a gaseous body which, by union with water, forms liquid muriatic acid. This is a colorless transparent liquid when pure, but, as found in commerce, has a yellowish or even a brownish tint. Its smell is acid, and its taste intensely sour and burning. When exposed to the air, it gives off dense white fumes. The sp. gr. of the medicinal acid is 1.16.

HISTORY.—According to a quotation in Pereira's *Materia Medica*, watery hydrochloric acid was probably known to Geber, the Arabian chemist, in the 8th century. Basil Valentine described it in the 15th century. Priestley, in 1774, obtained gaseous muriatic acid, the composition of which was first determined by Scheele.

ACTION. *On Animals*.—When injected into a vein it coagulates the blood, but not so strongly as sulphuric acid, nor does it, when absorbed from the stomach, have so decided an action upon this fluid.

The general symptoms produced by it are nearly identical with those of nitric acid.

On Man.—In small doses, medicinal muriatic acid occasions an agreeable warmth in the stomach, and generally some quickening of the pulse, cheerfulness, flushing of the face, and an increased flow of urine. Its protracted use sometimes causes salivation. In larger doses it excites the brain in a peculiar manner, causing giddiness, confusion of the senses, a sort of intoxication, in fine. In a diluted form it agrees better with the digestive organs than either sulphuric or nitric acid. This circumstance is explained chemically by the fact that it is more readily neutralized than the latter by the organic substances which it meets with in the stomach. It has a feeble caustic action than the acids mentioned. In a concentrated form, however, it combines with the albumen and the organized tissues of the stomach, acting as a caustic, attacking and corroding the coats of the organ. The symptoms it occasions resemble, in their kind, but are less in degree than those of the other mineral acids. There are signs of inflammation in the throat and alimentary canal, and at first, in some cases, an escape of acrid pungent fumes from the mouth. But the pain and the general disturbance of the system are less than the other acids occasion. A case is recorded in which an ounce of the officinal acid was swallowed by mistake, yet the patient recovered.¹

REMEDIAL USES. *Internally.*—In *typhus*, and in fevers of the *typhoid type*, this acid has been recommended by numerous authorities, of whom may be mentioned Fordyce, Hufeland, Jahn, Flajani, and Voigtel. But in spite of their decided eulogy of its virtues, it would be difficult to infer from their statements in what its eminent virtues consist. It is possible that its inspissating action on the blood may render it useful in typhus, but the fact that it is useful is far from being clearly established. Many writers, also, eulogize its virtues in *scrofula*, &c. Ferriar² states that he employed it in hospital and in private practice as a tonic in cases of *scrofula*, *phthisis*, *dyspepsia*, and *general debility*, and always found its effects to be an acceleration of the pulse, an agreeable glowing sensation in the stomach, a feeling of increased vigor and alacrity, and a heightening of the complexion. If this acid be, as it is asserted, a constituent of the gastric juice, its artificial increase in the stomach may promote the perfect solution and assimilation of the food, and in this manner tend to palliate or even cure diseases which frequently originate in a defect of the primary digestion.

¹ BECK, Med. Jurisp., ii. 340.

² Med. Histories, Am. ed., p. 387.

In obstinate cases of *secondary syphilis*, when the digestive and nutritive functions are feeble, and mercury cannot well be borne, hydrochloric, like nitric, acid may be given with advantage. In this country attention was early called to its anti-syphilitic virtues by Priolcau.¹ It has been a good deal used in cases of *stone* and *gravel*, and is generally prescribed theoretically for the phosphatic forms of these complaints. But in practice it seems to have been equally advantageous in lithiasis, a fact which must be attributed to its influence on the assimilative function, and its diuretic properties. It has also been employed in the treatment of *diabetes*.² Paris found it a very efficacious medicine in preventing the generation of *intestinal worms*, after the bowels had first been cleansed of them. But nearly all tonic medicines have a like influence. Sachs also found it useful in the verminous fever of scrofulous children, particularly when associated with cinchona, quassia, &c. In some *diseases of the skin*, as chronic eczema, it was used internally by Erichsen with success.³ Plenck recommended washes or ointments containing it in the treatment of tinea, itch, and psoriasis.

Externally.—In *diphtheritis* it was first strongly recommended by Bretonneau. He used a mixture of one part of the acid to two parts of honey; but others have preferred the pure acid, applied by means of a mop made by fastening a piece of soft sponge to a wooden handle with waxed thread. The acid should not be allowed to touch any part except that actually covered with the exudation, lest it tend to spread the morbid action. Richter⁴ mentions having used this application very successfully in an epidemic of measles, in which many of the patients were attacked with *gangrenous stomatitis*. It may also be administered in a gargle. The acid may be used after the same manner in *mercurial* and in *ulcerative stomatitis*, in hospital gangrene, in *scrofulous*, *scorbutic*, and other *ulcers* of low vitality, in *tinea capitis*, and in *frostbite*. For the last-named affection it was recommended by Linnæus. Foot-baths containing it have been prescribed in cases of *retrocedent gout*. For the removal of *warts* and small fungous growths it is often a successful application.

ANTIDOTES.—The alkaline earths, soap, and, in the absence of these, the bicarbonates of the alkalies, or some albuminous liquid.

ADMINISTRATION.—For internal administration the officinal *diluted* acid is generally prescribed, in the dose of from twenty to sixty minims, largely diluted with some mucilaginous liquid, and imbibed through a tube. The stronger acid may be given in about one-third

¹ CALDWELL'S Medical Theses, p. 104.

² Lond. Med. Gaz., 1846.

³ Lancet, Jan. 1854, p. 65.

⁴ Op. cit., iv. 69.

or one-half of that quantity. As a *gargle* the latter acid may be prescribed in the proportion of one or two fluidrachms to twelve ounces of water, sweetened with sugar or honey.

ACIDUM NITRO-MURIATICUM.—NITRO-MURIATIC ACID.

PREPARATION AND PROPERTIES.—This acid, the *aqua regia* of the older chemists, is prepared by mixing together one measure of pure nitric acid with two of hydrochloric acid. It has the remarkable property of dissolving gold and platinum, metals which are insoluble in either of its components separately. Like its constituent acids, it acts as a powerful corrosive poison when taken pure and in large quantities. In smaller doses it is very apt to disagree with the stomach, and it readily attacks the enamel of the teeth. From the experiments of Scott¹ it appears that when mixed with the water of a warm bath, so as slightly to acidulate this latter, it is absorbed, greatly increasing the acidity of the urine, and, after several repetitions of the process, exciting a burning sensation in the mouth and throat, a considerable discharge of saliva, and superficial ulcers of the mucous membrane, with redness and swelling of the gums. The bowels also are more frequently moved, and there is sometimes an increased tendency to urination. The secretion of bile is said also to be augmented.

USES.—Scott and also Guthrie² ascribed a curative efficacy to this acid in chronic enlargement of the liver arising from tropical diseases, in scrofula, secondary syphilis and chronic rheumatism, and in old and indolent ulcers; but the confession of the former, in a postscript to his original publication, that identical results are produced by sponging the skin with chlorinated water, destroys much if not all of the value of his previous testimony, and justifies the neglect into which the medical employment of the acid has now fallen.

ACIDUM SULPHURICUM.—SULPHURIC ACID.

ACIDUM SULPHURICUM DILUTUM.—*Diluted Sulphuric Acid.*

ACIDUM SULPHURICUM AROMATICUM.—*Aromatic Sulphuric Acid.*

HISTORY.—Sulphuric acid was discovered in the middle ages, and is mentioned by Basil Valentine (1415?).

NATURAL SOURCES.—It is found as a product of the sulphurous

¹ Amer. Med. Recorder, i. 81.

² Eclect. Repertory, viii. 157.

soil in certain volcanic regions. In 1776 it was detected by Baldassari in the hill of Toccoлина, near Sienna; Humboldt discovered it in New Grenada, in the waters of the Rio Vinagro (Vinegar River), whose name is derived from the sour taste its waters acquire from this acid.¹ Dr. Thompson states that in Persia there is an earth so strongly impregnated with it as to be used for an acidulous seasoner of the food.² Vauquelin detected it in the water of a lake in the island of Java.³ In the United States the Sour Springs, near Byron, N. Y., owe their name to the sulphuric acid contained in their waters.

MANUFACTURE.—The sulphuric acid of commerce is prepared by burning a mixture of sulphur and nitrate of potash or soda in an atmosphere filled with watery vapor. Sulphurous acid and nitric acid gas at first are generated, and by mutual reaction are converted into sulphuric acid and nitrous acid, which latter acting upon the newly-evolved sulphurous acid, converts it into a fresh portion of sulphuric acid.

PROPERTIES.—Sulphuric acid, or, as it is generally called in popular language, *oil of vitriol*, is a dense, colorless, inodorous, and transparent liquid, of an oleaginous appearance. Its sp. gr. is about 1.8433, or, when highly concentrated, as high as 1.845. It freezes above 32° F.—viz., at about 45° F.—when it has a sp. gr. of 1.78, and therefore ought not to be kept in closely-stopped glass vessels if the thermometer tends towards the freezing point. Owing to its singular facility for absorbing moisture from the air, it is liable to increase very greatly in volume, and on this account the vessels containing it ought to be kept carefully closed, and not entirely full.

Diluted sulphuric acid is the stronger acid diluted with thirteen times its volume of water. Its sp. gr. is 1.09.

Aromatic sulphuric acid, or *elixir of vitriol*, is made by digesting three and a half fluidounces of sulphuric acid with two pints of alcohol, and then adding ginger and cinnamon. It is regarded as an alcoholic solution of sulphuric acid flavored with aromatic essential oils. "It has a peculiar aromatic odor, and, when sufficiently diluted, a grateful aromatic taste." It is perhaps a more agreeable form for internal administration than the simple diluted acid.

ACTION. *On Vegetables*.—In a concentrated state, sulphuric acid abstracts the water of plants, and carbonizes the woody fibre; and, even when diluted, soon destroys their vitality.

On Animals.—When sulphuric acid is injected into the veins of an animal, it causes instant death by coagulating the blood. When in-

¹ MÉRAT and DE LENS, Dict. de Thérap., vi. 458.

² Mat. Med., i. 361.

³ THOMSON, Dispensatory, p. 174.

troduced into the stomach, the animal seems to suffer extreme pain, strives to vomit, utters plaintive cries, and, if restrained, struggles to free itself. If vomiting occurs, it is of a fluid containing liquid or partly carbonized blood, and the accidental contents of the stomach. On dissection, the œsophagus is found more or less blackened and inflamed, the mucous membrane of the stomach is ulcerated, softened, or in great part destroyed, and the walls of the organ may be entirely perforated by the acid. The blood contained in the heart is more or less firmly coagulated, and sometimes that also in the pulmonary vessels.¹

On Man.—The action of sulphuric acid upon the organism depends in a great degree upon its concentration. When applied boiling to the living tissues, it destroys them like red-hot iron; but sufficiently diluted for internal administration, its action is tonic, astringent, and inspissating, both locally and generally, for it is absorbed by the bloodvessels. It strengthens the appetite, quenches the thirst, and acidifies, to a greater or less extent, the secretions and excretions—the milk and urine, for example—lessens the frequency of the pulse, and renders the blood darker and more coagulable.² Although it does not itself pass off by the urine unless given in considerable quantities, it causes an excess of other acids in this secretion. Dr. Bence Jones is of opinion that the acid is first absorbed by the stomach, and afterwards eliminated from the system by the surface of the bowels.³ By habitual use this acid becomes very injurious to the teeth, even when greatly diluted; it whitens them, indeed, but also corrodes them. It also, sooner or later, enfeebles the digestion, produces colicky pains and diarrhœa, and impairs the nutrition. Marasmus, and even death, may be the ultimate result of its use.

In its more concentrated form this acid is a powerful escharotic, attacking the tissues violently in consequence of its affinity for the organic bases, as well as the water with which they are combined. When the strong acid has been swallowed in poisonous doses, it occasions a burning pain in the mouth, fauces, œsophagus, stomach, and bowels, with nausea, violent retching, vomiting of dark, bloody, and sometimes membranous substances, which, if they happen to fall upon a marble hearth, produce effervescence, together with all the signs of active acute inflammation, and, unless the action of the poison be arrested, with gangrene of the stomach, and death. The general symptoms are alteration of the voice, fetid breath, coldness of the extremities, a small pulse, difficult breathing, inability to swallow, intense anxiety, and intolerable pain. The mind usually remains

¹ ORFILA, *Toxicologie*, i. 126.

² WILMER, *Wirkung, &c.*, v. 309.

³ HEADLAND, *On the Action of Medicines*, p. 301.

clear to the last. After death the parts attacked by the acid are found covered with a corrugated crust of a white, yellow, brown, or even black color, and the subjacent membranes are often perforated, sphacelated, carbonized, or merely thickened, puckered, or wrinkled, according to their being more or less exposed to the first attack of the acid. The adjacent vessels are distended with dark and coagulated blood. The blood has been found coagulated even in the smaller arteries, the tibial, for instance. This effect may serve to explain several of the striking symptoms produced by the acid, such as the dyspnoea, the small or imperceptible pulse, the icy coldness of the whole body, the spasms of the muscles of the extremities, &c. A case is reported¹ in which the corrosive action of the liquid was confined to the respiratory apparatus, the digestive organs having entirely escaped.

When the poison has been less energetic, or appropriate treatment of its effects has been early resorted to, life may be preserved. The sloughs which it has produced may be cast off, and the ulcers may heal, but often with considerable thickening, hardening, and contraction of the tissues. In some cases death ultimately takes place as the result of stricture of the œsophagus, of ulceration and suppuration of this organ, or of the stomach, &c. Commonly there is also obstinate constipation, a scanty secretion of urine, and an augmented flow of saliva.

REMEDIAL EMPLOYMENT. *Externally*.—Owing to the difficulty of restricting the action of sulphuric acid when it is applied to the animal tissues, its powerful escharotic action is very seldom resorted to. It may, however, from this very quality, be more appropriate than solid caustics as an application to *poisoned wounds*, such as those made by venomous serpents, mad dogs, and other animals. This acid has been used as a caustic in cases of *ectropion* and *entropion*, in the latter by Helling, Quadri, and in both by Guthrie, Lawrence, and others. In entropion it is applied in the following manner. The skin of the inverted lid, to the breadth of about three lines, and one line from its tarsal edge, is rubbed with the acid, by means of a pencil of wood dipped in it, with the precaution of not taking up more than merely wets the pencil. After ten seconds the part is to be dried, and the acid reapplied, and this even a third or a fourth time, until a sufficient eschar has been formed, or marked contraction has taken place. The part is then to be carefully washed.² Of remedying the other deformity, Mackenzie says: "Some surgeons venture on the employment even of sulphuric acid for this purpose. The blunt end of a common silver probe is dipped in that fluid and rubbed upon the con-

¹ Lond. Med. Gaz., June, 1850.

² MACKENZIE, Diseases of the Eye, p. 227.

junctiva of the lid, carefully avoiding the punctum laerymale, earuncle, semilunar fold, and cycball. The application should be repeated every fourth day."

Appropriately diluted, this acid has been employed in a great variety of *ulcerations, venereal, cancerous, and scorbutic*, and particularly when a stimulant astringent is required to favor the separation of *sloughs*, or *fibrinous exudations*, or to render the reparative process more active. But in none of these cases is the application as advantageous as that of nitrate of silver. Its superior astringency may, however, give it the preference in certain flabby and ulcerated conditions of the skin or mucous membrane, and particularly of the *throat and mouth*. It has been recommended in *gangrene* of the latter by Van der Woordt, who regarded it as the most efficient of all local applications, and by Van de Weil, Jourdain, Brunneman, Courcelles, and others.¹

In several *diseases of the skin* sulphuric acid has been found useful. An ointment composed of one part of the acid to eight parts of lard was recommended by Crampton for *tinea capitis*, and the late Prof. Chapman states that he has cured the disease by its means. The use of sulphuric acid for *itch* seems to have originated with Cocthenius, a Prussian army surgeon, in 1756, and it has since enjoyed considerable favor among the physicians in charge of hospitals for the treatment of skin diseases.² Helwich, Bry, and Sedillot, are referred to by the author last quoted, and Fournier³ cites Lentin and Sala in evidence of its successful employment. Alibert prescribed it in conjunction with the alkaline sulphuret, and Dupuytren used a similar combination. The ointment of sulphuric acid, says Dr. Neligan, seldom fails to cure the disease.⁴ Eberle states that he repeatedly used a similar ointment with prompt success in itch, and also in a very distressing case of *prurigo formicans*. Chapman says that he removed itch by means of sulphuric acid lotions almost as speedily as with ordinary sulphur ointment. Over this preparation it has the important advantage of leaving no unpleasant smell, of not soiling the linen, and at the same time of allaying the itching quite as well.

Internally.—Hemorrhages. In those cases of hemorrhage which arise from "dissolution" of the blood, sulphuric acid has been profitably administered, particularly in *scurvy* and in *purpura*. It is certainly superior to all other mineral acids in these affections. Chapman is of opinion that it is sometimes effectual in restraining moderate uterine losses. According to Headland⁵ it is particularly efficient in hemor-

¹ N. Amer. Med. and Surg. Journ., xi. 389.

² J. P. FRANK, Path. Méd., ii. 279.

³ Dict. de Méd., en 60 vol., xvii. 210.

⁴ Dis. of the Skin, Am. ed., p. 115.

⁵ Action of Medicines, p. 303.

rhages from mucous membranes, because it probably passes off in small quantities from all mucous surfaces. For the same reason, perhaps, it is useful in diarrhoea, as will appear below.

Fevers. In fevers of a typhous type, drinks acidulated with sulphuric acid have been generally given when there was no tendency to diarrhoea. The symptoms which indicate its propriety are, according to J. P. Frank, flushed cheeks, burning skin, dry tongue, thirst, hemorrhage, or profuse sweats. It might rather be said that the stage and phenomena which follow these, and of which the symptoms are a dusky complexion; dry, harsh skin; black tongue and hemorrhage, call for the remedy, if it is needed at all, of which indeed there is much doubt. It must not, however, be concealed that some of the most eminent historians of this form of continued fever have attached great value to the use of sulphuric acid in its treatment. Among late writers, Neumann prefers it to all other acids. But he recommends it to combat the very opposite condition to that just described, at the commencement of the attack; when there is active delirium, and a full pulse gives the disease an inflammatory aspect, nothing, he says, will so soon dispel this semblance as sulphuric acid.¹ The diluted or the aromatic sulphuric acid is often useful in palliating the *colliquative sweats* of phthisis, particularly if associated with cinchona. This effect would seem to depend upon the fact that it is eliminated from the system by the skin. It ought not to be given if diarrhoea is also present. In other cases of profuse sweating, those in particular which depend upon general exhaustion, the usefulness of this remedy is more decided.

In *dyspepsia*, accompanied by alkaline pyrosis, it is useful by its direct chemical action, but not in this manner only, for it is no less serviceable when the excessive secretions of the stomach are acid. Doubtless its astringency acts upon the muscular fibre of the glands of the stomach, and in this way diminishes their secretion.²

This acid is mentioned by numerous writers as having been employed by Sydenham in *diarrhoea*. Of late years quite a number of reports have been published of its efficacy in this disease and in *cholera morbus*. It would appear that the cases in which it is most efficient are such as are independent of crude ingesta, those, in other words, which arise from atmospheric influences, and particularly such as assume the epidemic type of the affection, and resemble cholera. Dr. Miller³ seems to have employed the following formula with uniform success. R.—Acid. sulph. dilut. ʒij; tinct. cardamom. c. ʒij; aq.

¹ Heilmittellehre, p. 35.

² HEADLAND, op. cit., p. 302.

³ Lancet (Am. ed.), Dec. 1852, p. 424.

destillat. ̄vss. M. S. Take two tablespoonfuls at once, after every liquid stool or vomiting, and every four hours. Dr. Braithwaite¹ was no less successful in a large number of cases which approached in their character very closely to spasmodic cholera. He gave one minim in a tablespoonful of water, to adults, and to children one-third of a drop. Under its use bilious matter returned to the discharges, and warmth to the surface; but the cramps were not affected by it. In Austria a specific for cholera was used under the government patronage, and, it is said, with great success. It contained as its principal ingredient sulphuric acid mixed with about half its weight of nitric acid. A caution should be observed in treating bowel affections by sulphuric acid, which is, not to persevere in it if the first few doses fail to mitigate the symptoms, for in that case it is almost certain to aggravate them.

Lead Colic. The treatment of this disease by sulphuric acid was first proposed by M. Gendrin, who was induced to do so by observing the success of alum (sulphate of alumina and potassa), which had long been used for the same purpose. This was in 1830, and since then M. Gendrin has treated many hundreds of patients with sulphuric acid alone, and with nearly invariable success.² The duration of the cases seems to have been about three days in slight cases, and six or seven in severe ones. Forty-four drops of the acid were mixed with a pint of water, and two or three times this quantity was taken in the twenty-four hours. No other medicine was administered, but the patients used warm sulphur baths every day, by which the lead excreted upon the skin was turned black, and being thus rendered visible, was more easily removed. This process, which was repeated until all traces of lead disappeared from the skin, no doubt forms an important element of the treatment, because it removes the poison which would else be absorbed anew.

Sulphuric acid was also proposed by Gendrin as a prophylactic against *lead poisoning*, and his observations seemed to justify the proposal. In the same way Mr. Benson, of the Birmingham Lead Works, inferred from his experience that the acid is in a high degree efficient. It certainly seems to have had the effect of diminishing the number of attacks of lead colic in his manufactory.³ These results, it must be confessed, are met by opposing testimony which appears to be more decisive. Tanquerel⁴ has shown that those of the workmen in lead

¹ Times and Gazette, Dec. 1852, p. 629; see, also, PRETTY, *ibid.*, Nov. 1853, p. 512.

² DR. BENNETT, in *Lancet*, March, 1856, p. 378.

³ *Lancet*, Dec. 1842, p. 435.

⁴ *Maladies de Plomb*, ii. 497.

who use sulphuric acid drinks are sooner attacked than those who abstain from them, and Grisolle¹ arrives at the same conclusion, which, indeed, an impartial estimate of the facts of the case seems to warrant.

Sulphuric acid has sometimes been used for *gravel* and *stone*, and perhaps with advantage in so far as it has improved the tone of the digestive organs, and thereby restored the normal composition of the urine. Injections containing rather less than a drop of the dilute acid to an ounce of water, have been successfully applied to the cure of *gonorrhœa* by Dr. Miller, of Virginia.²

This acid has been recommended in a great variety of affections, including those of a convulsive form, and even in *epilepsy*, *hypochondriasis*, *hysteria* with profuse menstruation, chronic *singultus*, chronic *vomiting*, morbid *sensibility of the stomach*, &c.

It has been alleged by Brühl, Cramer, Roth, and others, in Europe, and by Dr. Brincklé in this country,³ that when the acid is administered in a bitter decoction, or in their usual drinks, to habitual *drunkards*, it destroys their appetite for alcoholic liquors. But this statement, it must be feared, has not been sustained by experience. When drunkards have been prevailed upon to acidulate with it all of the alcoholic drinks taken by them, they certainly have sometimes become disgusted with the mixture; but perhaps in no case have they been permanently restrained by it from indulgence in their former draughts.

ANTIDOTES.—The best are chalk, magnesia, carbonate of magnesia, and the alkaline bicarbonates. The alkaline carbonates are thought to be objectionable because they are themselves corrosive.

ADMINISTRATION AND DOSE.—When given internally, sulphuric acid must be largely diluted. One or two drops of the strong acid dissolved in eight fluidounces of water is about the average dose. Of the diluted and aromatic acids from ten to thirty drops in a wineglassful of water may be given three or four times a day. The doses stated are those of the *U. S. Dispensatory*, and nearly the same are given in other standard works. But the simple diluted acid is about one-fourth stronger than the aromatic, unless, as some have supposed, the alcohol in the latter preparation neutralizes a part of the acid by converting it into ether. This supposition is not, however, admitted by pharmacological chemists.

¹ Essai sur la colique de plomb., p. 66.

² Philad. Med. Record., v. 765.

³ N. Am. Med. and Surg. Journ., iv. 293.

IRRITANTS CHIEFLY ALKALINE.

LIQUOR AMMONIÆ FORTIOR.—STRONGER SOLUTION
OF AMMONIA.LIQUOR AMMONIÆ.—*Water of Ammonia.*

PREPARATION.—Water of ammonia is prepared by distilling hydrochlorate of ammonia (sal ammoniac) and quicklime with water. It is procured of two degrees of strength for officinal purposes, the one (Liq. Ammoniæ fortior) having a sp. gr. of 0.882 to 0.910, and the other (Liq. Ammoniæ) a sp. gr. of 0.950. The former is exclusively employed to produce vesication, either alone or in combination with lard (*see below*, the vesicating ointment of Gondret), or else united with oil or with tincture of camphor (*vid.* Lin. Ammoniæ and Lin. Ammoniæ Comp.). The latter is an imitation of Granville's counter-irritant lotion, but somewhat weaker, as the sp. gr. of this lotion was 0.872.

ACTION. *On Plants.*—The vapor of ammonia causes plants which are exposed to it to shrivel and fade.

On Animals.—If an animal is immersed in ammoniacal gas, it dies asphyxiated. In experiments performed by Mitscherlich,¹ rabbits were destroyed within three hours by two drachms of caustic water of ammonia. It occasioned uneasiness, great frequency of pulse, rapid breathing, and such prostration that the animal was unable to rise, and stretched itself out upon its belly. Tetanus followed, and a lingering agony. The stomach was found to contain a large quantity of reddish mucus, and its lining membrane was softened; the poison having penetrated the vessels, had dissolved the blood-corpuscles, and determined an exudation of their coloring matter, so that the fluid in the stomach contained only this matter, together with the cells of the peptic glands and mucus. In the small intestine there was much bloody mucus. The blood of the whole body was more or less fluid, and coagulated very slowly, forming a soft small clot. Its alkaline reaction was not greater than usual, and the blood-corpuscles retained their normal form. The bloodvessels of the stomach and small intestine were greatly distended with liquid blood, which in some places

¹ Lehrbuch der Arzneimittellehre, ii. 277.

had penetrated the tissues and stained the peritoneum red. When two drachms of water of ammonia were thrown into the peritoneal cavity of a rabbit, the same general symptoms as those just described were produced, except that there were evidences of greater suffering. The caustic dissolved the blood-corpuscles in the wound, and penetrated through the walls of the vessels, and even of the intestines, producing the same changes as when administered by the mouth, and in particular the softening of the lining membrane of the small intestine. The blood was not rendered more alkaline than before, and the urine continued to have an acid reaction. From these experiments Mitscherlich concluded that caustic ammonia, in large doses, corrodes and liquefies the solids; that it is not excreted by the bowels; that it renders the serum of the blood less coagulable, and dissolves the blood-globules when it comes into contact with them; that it does not render the urine alkaline, nor increase the alkalinity of the blood; that it exerts a specific action upon the mucous membrane of the small intestine; that it is not only absorbed by the bloodvessels, but also penetrates the tissues directly; and that it causes death by its action upon the blood and indirectly upon the spinal marrow.

On Man.—Externally. Various preparations of ammonia act with different degrees of intensity upon the skin, producing rubefaction, vesication, or merely softening of the cuticle. When caustic ammonia is applied to the skin, it excites a sense of warmth, followed by a burning pain, and, if the cutis be delicate, or the application long continued, a true inflammation, with more or less vesication. In two persons a space on the back of the hand was kept moistened with water of ammonia of sp. gr. 0.905, and containing about 27.5 per cent. of ammonia. At the expiration of nine minutes a smart pricking and burning sensation was felt; in twenty-five minutes the burning was stronger and the skin red; in half an hour small vesicles were perceptible, which gradually enlarged and coalesced, and formed, at the end of three-quarters of an hour, a large bulla. It was at first, however, but imperfectly distended. The adjoining skin was quite red. After allowing the surface to get dry, the pain and redness continued, the blister grew more distended, and afterwards shrivelled and got well like blisters from other causes.¹ The ammoniacal ointment of Gondret, when well prepared, produces a momentary sense of coolness in the skin, followed by heat and smarting. This sensation is said to be far less painful than might be supposed from the rapidity with

¹ MITSCHERLICH, op. cit., ii. 282.

which vesication occurs; indeed, it seldom excites complaint. In from five to fifteen minutes, according to the susceptibility of the skin, the cuticle is raised into a single bulla, or else the serum is contained in several vesicles joined together.¹ If, when the fluid is evacuated and the cuticle removed, a simple dressing be applied, there will be found, after the lapse of a few hours, a fibrinous exudation, the thickness and tenacity of which will depend upon the strength of the ointment and the duration of its contact with the skin. If it be intended to constitute the surface an absorbing medium for medicinal agents, this membrane must be removed; or if the object be to establish a permanent exutory, a somewhat longer application of the ointment will produce an eschar.

Internally. The vapors of ammonia, even when much diluted, excite a flow of tears, with inflammation of the eyes and irritation of the air-passages if applied to these parts. If they are long inhaled, as they are apt to be when employed to arouse persons from a state of insensibility, serious, and even fatal, consequences may ensue. Nysten tells us that a physician, for some years subject to epilepsy, was found by his servant in a fit. In order to rouse his master, the latter applied a handkerchief, moistened with this solution, to his nose so assiduously that he brought on bronchitis, of which the patient died on the third day. In the *Edinburgh Medical and Surgical Journal* there is the report of the case of a lad whose death was produced, or at least hastened, by an attendant applying ammonia to the nose, "with such unwaried but destructive benevolence," that suffocation had almost resulted. Dyspnoea, with severe pain in the throat, immediately succeeded, and death took place forty-eight hours afterwards. A French physician also suffered ulceration of the mouth and violent pulmonary catarrh in consequence of the excessive use of ammonia, given as an antidote for hydrocyanic acid. More recently another case of poisoning by the vapor of ammonia has been published. It arose from the accidental bursting of a carboy of liquor ammoniæ. The mucous membrane of the nose and lips was destroyed. The tongue was deprived of its epithelium, and a large quantity of sanguineous froth escaped from the mouth. The respiration was so difficult that suffocation was feared. The pulse was feeble, irregular, and frequent. There were no convulsions. Bronchitis supervened, but the patient recovered.²

When liquid ammonia is taken by the mouth, different symptoms

¹ TROUSSEAU and PIDOUX, *Thérapeutique*, i. 369.

² PEREIRA, *Mat. Med.*, 3d Am. ed., i. 429.

present themselves. Wibmer found¹ that five drops or less of it produced no effects beyond a sense of irritation or burning in the throat, but that doses of from ten to twenty-five drops caused a feeling of extreme tension in the temples, which lasted for several minutes; the pulse was somewhat more frequent and rather harder in some of the experiments, but in others it remained unchanged. To these phenomena may be added a general enlivening of the feelings, a sense of increased strength, augmented warmth of skin, a flow of perspiration and urine, and in bronchial affections a greater abundance of sputa and ease of expectoration.² The tendency of the medicine to produce diaphoresis may, as in other similar cases, be greatly increased by the use of warm drinks and external warmth. These effects, it will readily be perceived, are very unlike those produced by diffusible stimulants, particularly of the alcoholic sort. Ammonia does not, like wine and opium, excite the circulation nor stimulate the mental faculties, nor does any evident depression follow the transient excitement which it produces of the secretory and motor functions. Indeed, its physiological action upon the healthy system is extremely slight and fugacious; but when the nervous system, and with it the circulatory and secretory functions are enfeebled, the evidences of its power are incomparably more distinct.

When given in large doses, caustic ammonia may act as a deadly poison, yet cases of its toxical effects are comparatively rare, because, no doubt, its penetrating odor prevents its being often swallowed by mistake. Yet it is sometimes taken in this way. Plenck relates that a man who had been bitten by a mad dog had administered to him a glassful of ammonia. His lips, tongue, and gums turned black immediately, and he died within four minutes.³ Several other cases may be alluded to, of which two are quoted by Mr. Taylor.⁴ In one of them two drachms of the liquid caused violent vomiting and bloody stools; in a second, a drachm and a half was taken, and death, in excruciating agony, soon afterwards occurred. Another case is reported,⁵ by Dr. Barclay, in which there was severe pain in the stomach and vomiting of blood, which continued for three days, after which the stomach continued to be excessively irritable, and the bowels obstinately constipated. In four weeks the patient died from starvation. A fourth case may be mentioned⁶ in which strong ammonia was taken with a suicidal intent. The symptoms were general collapse, serous and bloody

¹ Wirkung, &c., i. 123.

² STRUMPF, Handbuch, i. 854.

³ MITSCHERLICH, loc. sup. cit.

⁴ On Poisons, Am. ed., p. 225.

⁵ Med. Times and Gazette, Nov. 1853, p. 553.

⁶ Annales de Thérapeutique, iii. 443.

diarrhœa, and bloody vomiting, clearness of the mind, excruciating pain in the abdomen, and death in six hours. Dissection of the bodies of persons killed by this poison discloses marks of violent inflammation, sometimes of the pseudo-membranous form, in the fauces and œsophagus, inflammatory redness, softening, or ulceration of the gastric mucous membrane, and, to some extent, of the small intestine also. The blood is generally liquid.

But large doses, even, of ammonia are not always fatal, as the following case will prove.¹ A wineglassful of strong liquor of ammonia was taken by a female, by mistake, for acetate of ammonia. As soon as she had swallowed it she fell back insensible, and as if strangled. Between four and five hours afterwards she complained of severe burning pain in the throat, epigastrium, and left hypochondrium, all of which parts were tender upon pressure. Her pulse was 53, and small, and her voice whispering. The debility was great, the countenance anxious, the pupils widely dilated; there was inability to swallow, the mucous membrane of the tongue peeled off, and there were convulsive twitches of the right arm. These symptoms gradually abated during the next three days, but a severe darting pain about the root of the nose continued, and diarrhœa afterwards came on, which, however, may have been due to laxatives which were injudiciously administered. In a fortnight the patient was convalescent.

REMEDIAL EMPLOYMENT. *Externally.*—The use of ammonia as a counter-irritant seems first to have been proposed by Gondret in 1821. Three years later, M. Vaidy published an essay on the *modus operandi* of this application, and, in 1838, Dr. Granville drew more general attention to its use by a popular essay "On Counter-irritation," in which the precise nature of the preparation employed by him was purposely concealed. It turned out, however, to be nothing more than strong water of ammonia diluted with spirit of camphor and spirit of rosemary, to the extent of about one-half. The preparation became a popular remedy, and was sold in this country under the name of *Granville's lotion*.

In all cases requiring prompt vesication of the skin, caustic ammonia is of great utility. It is unnecessary to enumerate the particular cases in which it may be applied, for they include all in which the severity of the pain or the danger of delay calls for a prompt resort to counter-irritation. Such are *congestion of the brain or lungs*, the paroxysms of *rheumatism*, *chronic gout*, *neuralgia*, and *various spasmodic pains*. The mode of application and its effects must be deter-

¹ Reported by Mr. E. P. Wilkins; *Lancet*, 1846, i. 385.

mined by the peculiarities of each case. When full vesication is desired, Gondret's ointment forms the most powerful agent for producing it; if a superficial blister is sufficient, the strong water of ammonia may be applied; when rubefaction only is intended, one of the ammoniated liniments may be employed.¹ For local pains, of a rheumatic or neuralgic character, ammonia forms an excellent palliative, and when the attack is slight, or arises from temporary causes, it is sometimes curative. For neuralgia, the best mode of procedure is the following. Take small disks of cloth, about a half or three-quarters of an inch in diameter, and apply them, moistened with the ammonia, over such points in the course of the affected nerve as are tender upon pressure, or are the seat of spontaneous pain. Cover the pieces of cloth with coins, buttons, or other convenient bodies, to prevent evaporation. As soon as slight vesication occurs, the pain is relieved, yet not so thoroughly as when the same effect has been obtained by means of cantharides. The less active liniments, containing ammonia, are more appropriate for preventing the development of inflammation, particularly such as cold produces. In commencing sore-throat, laryngitis, pleurisy, rheumatism, &c., brisk frictions with one of these preparations should be made in the neighborhood of the affected part.

Lavagna employed injections, into the vagina, of ammonia (ten or twelve drops to an ounce of milk) for the purpose of restoring *suppressed menses*. Sometimes the discharge returned within twenty-four hours, and sometimes not for five or six days. The injection produced an unpleasant sensation and sometimes even pain, with a white discharge, but no further annoyance.² Mérat and De Lens state that it proved unsuccessful in the only case in which they employed it.³ They, however, used it with advantage in several cases of simple *leucorrhœa*. In nervous *debility of the eyes*, and commencing *amaurosis* produced by fatigue of these organs, or their exposure to an intense light, the vapors of ammonia, very carefully diluted, may be inhaled

¹ The vesicating ointment of Gondret, as improved by M. Trousseau, is prepared in the following manner. Take of fresh lard and of ammonia, at 22°, each four drachms, and of tallow from half a drachm to one drachm. Melt the lard and tallow in a wide-mouthed bottle, dipped into hot water for this purpose. After removing it, and as soon as the mixture begins to assume an opalescent appearance, add the ammonia, stop the bottle, and shake it until the contents acquire a creamy consistence, then cool it in water. If, instead of having a uniform consistence, the mixture contains lumps, it must be prepared anew, for this condition denotes the presence of uncombined water of ammonia. Unless great care be taken, this preparation will produce a more or less superficial slough, and a permanent cicatrix. For these reasons, it should seldom be employed upon the face or other exposed portions of the body.

² Vogt, *Pharmakodynamik*, i. 226.

³ *Dictionnaire de Mat. Méd.*, i. 239.

by the nostrils, and allowed also to act gently on the globe of the eye itself. This method, although very useful, and recommended by some very high authorities, of whom Scarpa may here be cited,¹ is believed to be inferior to that by vapors of sulphuric ether employed in the same manner. *Burns* that do not involve the true skin may be cured, according to Guérard, by water of ammonia applied upon compresses. Simple exclusion of the air by raw cotton is more certain and less painful. *Frost-bite* in its first stage is more readily relieved by local stimulants than by any other means; and the ammoniated liniment is one of the best.

Internally.—In protracted *idiopathic fevers*, with prostration, dulness of the intellect, and a want of vitality in the skin, this medicine forms a useful adjuvant to alcoholic and nutritive stimulants, and stimulant diaphoretics. In *exanthematous fevers* when the eruption is tardy or imperfect, in *intermittents* during the cold stage, &c., water of ammonia has been recommended as a stimulant,² but it is less effectual than the carbonate of this alkali.

It has been recommended to use inhalations of ammoniacal vapor in the forming stage of *coryza*, *tonsillitis*, and even *pulmonary catarrh*, and they may undoubtedly be serviceable if judiciously employed. Mr. Smee³ recommended the use of ammoniacal inhalations very strongly, and devised an inhaler for their more convenient administration. Of the proper strength of the solution to be used he says: "It is preferable not to employ a solution stronger than the liquor ammoniæ of the shops, or weaker than the same diluted with twenty or thirty times its quantity of water." The value of this remedy is seen, according to Mr. Smee, in relieving dryness of the throat, with an accumulation of hardened mucus in the fauces; chronic hoarseness, especially that which often follows influenza; the relaxed and semi-œdematous state of the pharynx and larynx, which often affects public speakers, and others exposed to the hot and impure air of crowded rooms; commencing tonsillitis; old standing cases of asthma (those, probably, which depend upon emphysema or catarrh of the lungs); and morbid susceptibility of the respiratory tubes to the impression of cold air. It also acts as an antidote to the vapor of bromine and of prussic acid. In any of these cases the presence of acute inflammation or of marked fever forms a contra-indication to the use of the remedy. Under very similar conditions of the larynx and respiratory tubes, cauterization of the fauces was resorted to by MM. Hervieux and Rayer.⁴

¹ Bull. de Thérap., xliii. 135.

² STRUMPF, Handbuch, i. 854.

³ Lond. Med. Gaz., March, 1843, p. 59.

⁴ Bull. de Thérap., xxxiii. 159.

Moderate degrees of *sourness of the stomach* with an extrication of gas in this organ, especially when it results from constitutional debility of the nervous system, are greatly relieved by a few drops of the aromatic spirit of ammonia in water. At the same time it calms the nervous agitation which commonly attends this state. In veterinary medicine, ammonia is employed with complete success to relieve gaseous distension of the paunch (*tympanitis*) in ruminating animals that have fed too largely upon certain kinds of grass or upon fermenting hay.

In *spasmodic coughs*, generally, and in *whooping-cough*, especially, it may, in combination with antispasmodic medicines, serve to palliate the violence of the paroxysms. Such cases, however, of its curative effects as have been reported by Lévrat-Perroton,¹ are altogether inconclusive. It has also been thought useful in *epilepsy*. Pinel saw an attack prevented by ammoniacal inhalations. The patient (a watchmaker) had intimations of the approaching paroxysm from certain feelings; but he found, by inhaling the vapor of ammonia, it was frequently prevented. In the case of a confirmed epilepsy, which Pereira was in the habit of watching for some years, he believed that he had seen analogous beneficial effects.² Herpin states that this method sometimes succeeds in arresting the incipient paroxysm.³ *Syncope* from debility, or from a strong nervous shock, is habitually relieved by ammonia applied to the nostrils, or swallowed. In this connection it is proper to insist upon great caution in using liquid ammonia for the purpose of recalling persons from a state of unconsciousness. Owing to its incautious use the lips, nose, and eyes of patients have been violently inflamed, and even become gangrenous.

In asphyxia from drowning it has sometimes excited a renewal of the vital actions. It should not, however, be employed to the neglect of artificial breathing, heat, frictions, &c., nor persisted in so as to inflame the nostrils.

Poisoning by Hydrocyanic Acid, &c.—There is a difference of opinion in regard to the utility of ammonia in poisoning by *hydrocyanic acid*. Mitscherlich inclines to the opinion that its combination with this acid does not lessen the effects of the poison.⁴ Orfila says,⁵ "It would be absurd to consider ammonia as an antidote of prussic acid." Yet he admits that the *inspiration* of a slightly ammoniacal liquid may successfully rouse the system from such a degree of depression as would otherwise prove fatal. But caustic ammonia, used either by inhalation

¹ Revue Méd., xciii. 172; Annuaire de Thérap., vi. 257.

PEREIRA, The Elements, &c., 3d Am. ed., i. 432.

² De l'Epilepsie, p. 604.

⁴ Op. cit., ii. 281.

⁵ Méd. Légale, i. 335.

or swallowed, he regards as augmenting the danger by its corrosive action. Christison, however, calls it "probably the best antidote for poisoning with hydrocyanic acid," and in this opinion Pereira concurs. Murray, of Edinburgh, was so convinced of its efficacy by experiments which he made on animals and on himself, that he did not hesitate to declare his willingness to swallow a poisonous dose of prussic acid if he could be certain of having ammonia at once administered to him.¹ Probably the stimulant effects of the ammonia upon the nervous system and the heart, are the source of its efficacy, rather than its chemical combination with the poison; but of this latter there can be no reasonable doubt. It is in the former manner, doubtless, that its usefulness as an antidote to other narcotic poisons must be explained. It is a prompt and effectual antidote to *alcoholic intoxication*. The writer has seen a man who was taken from the gutter in a state of complete and helpless drunkenness, speedily restored to his senses and the use of his limbs by a few drops of ammonia in water, poured down his throat. A very similar instance occurred in the wards of Dupuytren at l'Hôtel Dieu,² and others are related by Piazza.³

A number of writers testify to the usefulness of ammonia as an antidote to the poison of venomous reptiles and insects, and even of rabid animals. Except the last, these forms of poisoning appear, to a certain extent, to be controlled or mitigated by ammonia. Certain it is that, when applied to the recent punctures made by *bees*, *wasps*, *spiders*, &c., the pain and inflammation subside at once. Many examples of its successful use in poisoning from the bite of *vipers* are recorded by Jussieu, Rasori, Hufeland, Michon,⁴ and others. It is proper to state that its efficacy has been denied by Fontana and by Gaspard, on the ground chiefly that the bite of these reptiles is seldom fatal. But such an explanation cannot be admitted in regard to the bites of the *rattlesnake* and the *moccasin*, and for these its efficacy seems to be established in a certain number of cases at least. Dr. Moore, of Mississippi, has published valuable testimony upon this point.⁵ He reports seventeen cases of poisoning by one or the other of these serpents which were cured by ammonia. Three of the cases are related at length, and are not less surprising as proofs of the efficacy of the alkali than remarkable for the enormous doses of it taken by his patients. He administered not less than a fluidrachm at a time, in a wineglassful of cold water, and applied the solution also to the wound. The patients were all negroes. Their symptoms were alarming, but were mitigated

¹ EBERLE, Therapeutics, p. 403. ² Bull. de Thérap., vii. 131. ³ Ibid., vii. 161.

⁴ Bull. de Thérap., xxxi. 70. ⁵ Am. Journ. of the Med. Sci., i. 341.

directly the alkali was made use of. Dr. Heustis speaks of this medicine as being the popular domestic remedy in Alabama for the bite of rattlesnakes, and states that a teaspoonful of it in water is given every fifteen minutes until relief is obtained.¹

Ammonia has also been vaunted as an antidote to the effects of *poisonous mushrooms*, but Paulet has proved it to be injurious rather than salutary.²

ADMINISTRATION.—The dose of liquor ammoniæ is from ten to thirty drops, largely diluted with water.

When it is intended to produce vesication with either of the preparations of ammonia described in this article, it is only necessary to saturate some porous material with the liquid, and, having applied it to the skin, to cover it with some impermeable substance. When the surface to be irritated is large, a piece of cotton or woollen cloth and the bottom of a plate or tumbler are convenient means for the purpose; when small, as in vesication for the relief of neuralgia, a thimble, an egg-cup, or a watch-glass, with a pledget of lint or cotton-wool, may be employed. From three to ten minutes generally suffice to produce the desired effect. Gondret's paste may be formed into a disk of the size of a half-dollar or less, and with a spatula applied until a slight blush around its edges shows that the purpose is accomplished. Rubefaction with ammoniated liniments is best produced by gently rubbing them into the skin with a piece of flannel.

ANTIDOTES.—Vinegar, lemon-juice, or any vegetable acid, may be used to neutralize whatever ammonia remains uncombined in the system; after which a moderate antiphlogistic treatment is necessary to palliate its secondary effects.

POTASSA.—CAUSTIC POTASSA.

LIQUOR POTASSÆ.—*Solution of Potassa.*

POTASSÆ CARBONAS.—*Carbonate of Potassa.*

These preparations, which are of different degrees of strength, but essentially the same in quality, may be conveniently considered together. The first, as its name implies, is exclusively employed for external diseases, or those of organs directly accessible, while the second and third are used both externally and internally.

¹ Am. Journ. of the Med. Sci., vi. 83.

² ORFILA, Med. Legale, ii. 680.

Potash seems to have been known in the pure and solid form as early as the thirteenth century, and in solution much earlier,¹ as appears from the description by Pliny of a soap made with tallow and ashes, of which he describes a hard and a soft variety, and which, according to him, was used to give the hair a light color.²

Potassa is obtained from the carbonate of potassa by treating this latter with slaked lime. It is generally found in the shops as a *hydrate*, containing some impurities which give it a bluish or grayish color, and prevent its perfect solubility in water and in alcohol. But it dissolves completely in either of these liquids when pure, and is then also of a white color. It absorbs water and carbonic acid rapidly from the air.

Carbonate of Potassa, as used in medicine, may be prepared from the impure salt which is known in commerce as pot and pearlashes, and which is produced by the incineration of wood. It is procured officially by the action of heat on bitartrate and nitrate of potassa. This salt is difficult of crystallization, and is generally met with in a granular state. It has a strong alkaline taste and reaction with chemical tests. It is white, inodorous, and has a remarkable affinity for water.

Liquor Potassæ is a solution of potassa in water, procured by removing the carbonic acid of the carbonate from a solution of this latter by means of lime. It is a clear, colorless, and inodorous liquid, with a very acrid taste. When rubbed between the fingers, it has a soapy feel, in consequence of its union with the fatty matters it there comes into contact with.

ACTION. *On Animals.*—Hertwig³ injected five grains of caustic potash, dissolved in a drachm of water, into the veins of a dog. Immediately the breathing grew labored, there were signs of great suffering, followed by exhaustion, paralysis, suspension of the pulse, and death in the course of forty minutes. The same experimenter injected from twelve to twenty grains of potassa, with three ounces of water, into the veins of a horse. The animal became rather more lively, and its warmth increased, the mucous membrane of the fauces became darker, the pulse was small and frequent, and the breathing labored; there was also yawning, stretching of the limbs, retroversion of the head, and a disposition to urinate. At the expiration of half an hour or more the animal seemed dull and weak, but in three or four hours was well again. According to Viborg's experiment, in which half a drachm of potassa, dissolved in two and a half drachms of water, was injected

¹ CHRISTISON, Dispensatory.

² Hist. Nat., xxviii. 51.

³ WILMER, Wirkung, &c., iv. 304.

into the jugular vein of a horse, there was general excitement of the system; the pulse, breathing, and temperature were rendered more active and intense; the bowels were moved, and the animal seemed to hunger. In the course of an hour the pulse became quick and small, and the horse stretched himself in a singular manner, and turned his head towards his loins. Shortly afterwards he urinated copiously, and speedily recovered.

Experiments on dogs were early performed with this substance by Bretonneau.¹ Forty grains of it were injected into the stomach of the animal, and produced repeated vomiting of a frothy liquid, with bloody stools of an alkaline character. On the morrow the symptoms had subsided, but for a week the appetite was less than usual. After the lapse of this time sixty grains of the alkali were administered, and the same symptoms arose. Several weeks afterwards the animal was strangled, and the mucous and cellular coats of the greater curvature of the stomach were found to be entirely destroyed; the rest of the stomach, and the commencement of the small intestine, were inflamed. In Orfila's experiments on dogs very similar results were obtained, but the animals appeared to suffer more severely. This difference arose from the fact that Orfila at first merely introduced the caustic into the animal's mouth and throat, whereas Bretonneau, and, in some later experiments, Orfila also, passed the poison into the stomach, through an appropriate tube, so that the fauces and œsophagus, in which the common sensibility is much greater than in the stomach, were not cauterized.

On Man.—In its solid state, pure potassa is the strongest of all caustics. When brought in contact with the living tissues, it neutralizes the free acids, and decomposes whatever ammoniacal salts may be present, causing the evolution of ammoniacal gas. It combines with fibrin and albumen, forming soluble compounds. Gelatin also is readily dissolved by it, and any phosphate of lime which may be present is deposited.² Hence potassa, and the alkalies generally, are of all corrosive poisons those which most frequently perforate the stomach when taken internally.

When allowed to remain in contact with the surface of the body, potassa occasions for several hours a deep, burning pain, and produces a leathery and blackish slough, which, however, is not dry like that of lunar caustic. It sooner or later separates at the edges, and is cast off, leaving a clean and healthy ulcer beneath. The period of its separation varies considerably, and depends upon the depth to which the life

¹ Archives Gén. de Méd., xiii. 373.

² PEREIRA, op. cit.

of the cutis has been destroyed. If the entire thickness of the integument is not involved, the separation of the slough may require several weeks. The surrounding inflammation is seldom severe or extensive, and the surface of the sore produced soon secretes well-conditioned pus. If used incautiously, this caustic may become mischievous. Buchner saw¹ gangrene and death produced by it in a case in which a quack had employed it to remove a wart. When the caustic action is *feeble*, and the slough more imperfect, the separation of this latter is longer delayed, and the resulting ulcer is less active, its granulations being often large and loose.

The symptoms of *poisoning* by potassa are enumerated by Orfila as follows: An acrid, urinous, and caustic taste in the mouth, a burning sensation in the throat, nausea, vomiting of matters which are often bloody and have an alkaline reaction, copious alvine dejections, severe pain at the epigastrium, and excruciating colic, convulsions, delirium, a cold, clammy skin, and, if the dose has been large, speedy death. Sometimes the caustic action of the poison upon the larynx produces suffocation; sometimes the digestive organs are the seat of the fatal disorder, and occasionally death takes place after the lapse, it may be, of several weeks, and appears to depend upon injury of the organs by which the primary steps of digestion are performed. The patient wastes away from inability to assimilate nourishment and from diarrhoea, and he may, in addition, suffer from stricture of the œsophagus. The *lesions* produced by the corrosive action of potassa, in cases of poisoning by that substance, consist of softening, abrasion, or ulceration of the mucous membrane of the mouth, œsophagus, and stomach, and a dark color of these parts.

In small or *medicinal doses* the action of liquor potassæ is that of an antacid, particularly if taken soon after meals.² It combines with hydrochloric or with lactic acid, and then, doubtless, passes into the circulation. If taken on an empty stomach, it probably enters the bloodvessels unchanged, and in from thirty to ninety minutes an increased flow of slightly acid urine occurs, which contains the whole of the potash taken. Soon afterwards the urine regains its original composition and acidity. When this, or indeed any, alkali is used habitually, it tends to lessen the proportion of fibrin in the blood. This circumstance has long been familiarly known, for the older writers observed that the long-continued use of the medicine gave rise to a general cachectic condition, with paleness and puffiness of the skin,

¹ WIBMER, *Arzneim. u. Gifte*, iv. 305.

² PARKES, *Brit. and For. Med.-Chir. Rev.*, Jan. 1853, p. 272.

passive hemorrhages, and general emaciation, a state, in fact, that bore the closest analogy to scurvy, and very probably depended upon the same condition of the blood which exists in that disease. This property of the medicine helps to explain its efficacy in moderating the tendency of the system to plastic exudations, and in promoting the absorption of those already formed. It also suggests a caution in prescribing it for numerous cases of lithiasis and gout, in which its temporary palliative influence is more than counterbalanced by the permanent debility of the system which it induces.

The action of *carbonate of potassa* is essentially the same as that of the dilute caustic solution just described, and of the alkalies generally. Like these, it is poisonous in large doses, and it produces effects similar to theirs. But in small doses, and appropriately diluted, it is less nauseous and less irritating to the digestive organs, and is, on this account, more suitable than caustic potash for internal administration.

REMEDIAL EMPLOYMENT. *As a Caustic.*—The caustic action of potassa has been much employed to promote the healing of *callous sores* and sinuses, and to destroy the fungous granulations which hinder the cicatrization of such ulcers. It was also used at one time to excite inflammation of the parts covering *hernial* apertures, and in this manner to produce a solid cicatrix capable of preventing the protrusion of the bowel. Granulations produced by the *in-growing nail* may be more effectually removed by caustic potassa than any other escharotic. A weak solution of the alkali, or of its carbonate, is a useful stimulant for indolent ulcers. Caustic potassa has been used to destroy *chancres* in their origin, and by that means to prevent constitutional infection; but the method is more painful and probably not more effectual than that by lunar caustic. *Poisoned wounds*, such as those inflicted by venomous serpents, and by rabid animals, have been treated by this caustic. It may be doubted whether the latter class of injuries derived any benefit from the treatment unless it was resorted to immediately after the infliction of the wound. Excision of the bitten part, followed by the application of caustic to the bleeding surface, may perhaps be warranted when the bite is inflicted by a really hydrophobic animal, but milder remedies than either are more suitable to all other poisoned wounds.

Absorption of the products of inflammation is often promoted by the use of caustic potassa, yet it may be doubted whether it is more effectual than blisters and other counter-irritants. Commencing suppuration in *paronychia* has frequently been arrested by such an application of the caustic as will produce a thin and superficial eschar over the seat of pain. Sometimes it is employed in prefer-

ence to the knife for evacuating scrofulous abscesses. The proper conditions for its use are, according to Vogt, as follows: When the swelling is not too large and distended, does not depend on a deep constitutional taint, and has not been of very long standing, and especially when the after-treatment is prudently conducted. The best surgeons, however, seem to have quite discarded this method. And, indeed, its advantages are the very reverse of apparent. In chronic or subacute inflammation of the large joints, the potential cautery has been much used as a counter-irritant and derivative, and especially in *coxalgia*. For this disease the issue was established behind the great trochanter. In 1805, Dr. Hartshorne, of Philadelphia, proposed to treat *ununited fractures* by applying the caustic alkali to the neighboring integuments. Cline applied it to the ends of the fractured bone, and Dr. J. Rhea Barton combined both of these methods in the same case, and with success.¹ It is well known that many quacks have used caustic preparations to destroy *cancerous tumors*, and sometimes a cure has followed the treatment. Trousseau has also employed the Vienna paste successfully for this purpose, but it is of inferior value to arsenious acid, and also to the chloride of zinc. *Carbuncles*, which are always painful and tedious, ought, as is well known, to be divided by crucial incisions. The disease is still further abridged when the cut surfaces are thoroughly cauterized with potassa. The Vienna caustic has been successfully employed in some cases of *erectile tumors*, and also to cause the obliteration of *varicose veins*, but is objectionable on account of its painfulness, tediousness, and uncertainty. In *traumatic tetanus*, caustic potassa has been used by several physicians to produce counter-irritation over the spinal column. Cases demonstrating its efficacy have been reported by Hartshorne,² Thomas, of Maryland, Lewis, of Pittsburg,³ and others. It is true that an author of repute, Curling, denies⁴ that counter-irritation can be of service unless the disease be inflammatory. But the fact that it is of service is well established, and is of more consequence than the question of the inflammatory nature of the disease, which is not settled nor in all probability will be.

As a *mild irritant*, the carbonate is superior to pure potassa, and was, at one time, almost universally preferred. It is now, however, but seldom employed. It has been prescribed in baths for the relief of various spasmodic diseases, including *tetanus*, *puerperal convulsions*, *epilepsy*, &c.; for *paralysis* following apoplexy; for chronic *gouty* or *rheumatic* affections of the joints, chronic *glandular swellings*, *suppressed*

¹ Am. Med. Recorder, ix. 275.

³ Am. Med. Record., iii. 170.

² Eclec. Repert., vii. 245.

⁴ On Tetanus, 150.

cutaneous eruptions, &c. For the treatment of scaly and chronic vesicular eruptions of the skin, the salts of potash may be used, but soda and its preparations are generally preferred.

Internal Use.—Gastric and Renal Diseases. The employment of alkalies in diseases of the urinary apparatus is not of recent date. The celebrated areanum of Mrs. Stephens, which was purchased by the British Government for £5,000, consisted essentially of calcined eggshells. Other secret remedies have turned out to consist of more or less strong preparations of wood ashes. That of Sehenek was an impure carbonate of potassa (*sal absinthii*). Mascagni employed this salt as an antilithic in his own person. These empirical remedies led to the introduction into medicine of alkaline preparations in the treatment of calculous disorders, and a rationale of their action was constructed on chemical principles, according to which the medicine neutralized and rendered soluble the lithic acid of which so large a proportion of urinary concretions consists. But neither the empirical nor the so-called rational use of the medicine has answered fully to its first renown, and indeed it is now regarded by many physicians as little more than a palliative. Employed with this view, potassa and its carbonates are unquestionably useful by suspending the formation of acid concretions in the urinary passages, as well as by neutralizing the excess of acid which is at the same time secreted in the stomach. But since this latter is the primary source of the evil, tonic medicines, and aromatic bitter infusions particularly, must be used to prevent its secretion, by giving tone and activity to the digestive organs. The gastric symptoms which call for the employment of alkaline medicines are principally heart-burn, sour eructations, aphthæ, spasm of the œsophagus, vomiting, cramp in the stomach, colic, and irregular diarrhœa. But it should not be forgotten that this treatment is palliative merely, and if too long continued must weaken the digestive powers and the whole system. Trousseau, indeed, remarks that the salutary effects of the medicine are not confined to the period during which it is taken, and insists that the alkalies are remedial by more than a chemical agency. So far as relates to the benefits derived directly and exclusively from them, this position may be questioned. It is indeed true that for months, or even years, after an attack of gravel, in which alkaline medicines were used, the calculous discharge may be suspended. But it is not uncommon for calculous deposits to cease from the urine spontaneously, and for a long time after an attack in which sand and gravel have been freely discharged. The whole calculous formation seems to have been gotten rid of, and that, perhaps, by means of a change already set up in the character or amount of

the urine, so that without any specific treatment the disease appears to have been cured.

Inflammations. Carbonate of potash, according to Richter,¹ holds out a promise of usefulness in those inflammations which tend to plastic exudation, and those especially which affect the lymphatic vessels and glands and the mucous and serous membranes. In these cases its operation is thought to be analogous to that of mercury. The appropriate period for its exhibition is stated to be after the active symptoms have been reduced by antiphlogistic measures, and when the products of inflammation show a tendency to permanence or to morbid degeneration. When taken for a long time, it does undoubtedly diminish the plasticity of the blood, but that it can act thus with sufficient promptness to cure acute inflammations is more than doubtful. Yet upon this ground, and upon the further observation that concrete fibrin is soluble in caustic alkaline solutions, it would seem to have been recommended in croup. Nor is testimony in its favor wanting. Hellwag and Voos allege that it is often of very essential service in this disease; Dorfmueller cured cases of it in which, until this remedy was used, there seemed no hope of recovery. Eggert regarded it as a specific for croup. But the testimony of these writers, and of others who report similar success, loses much of its weight when it is known that along with the alkali other remedies were employed of well-established power, such as mercurials, blistering, &c. Hufeland advises this alkali not only in croup, but also in pneumonia and other inflammatory affections. Mascagni and Setürner testify to the same purpose. The method has nevertheless failed to obtain confidence, and is certainly inferior to depletion, and to mercurials, in the cases for which it is recommended. Perhaps, as some have suggested, it might form a useful associate to mercurial medicines. Potassa and its carbonates have been recommended in whooping-cough, but do not now enjoy any confidence.

Dropsy. The diuretic powers of carbonate of potassa have already been alluded to. It would seem to be particularly applicable to those cases of dropsy in which the effusion results from suppressed perspiration, or from exposure to cold after scarlatina and other eruptive fevers. In the first-mentioned forms this medicine, like all the saline diuretics, has been found advantageous. Chapman mentions, as the cases in which carbonate of potash is most useful, those which are connected with great depravation of the digestive powers, and acidity of the stomach.

¹ Ausfürlich, Arzneim., iii. 521.

Scrofula. Numerous writers testify to the usefulness of liquor potassæ in *scrofula*. Of these Brandish (1811) was one of the most noted. He administered the medicine in very large doses. For a child six or eight years old, he prescribed a drachm daily, and for adults three or four times that quantity. But the apparent efficacy of the medicine was undoubtedly due in a great degree to the nutritious diet and the hygienic measures employed at the same time. The form of *scrofula* in which he found it most effectual was the glandular, a form which, more than any other, is amenable to treatment. Dzondi employed the same method, and with such success, it is said,¹ that often in from two to six weeks the swollen glands, the inflamed eyes, and the ulcerated skin, were cured. Sundelin regarded the usefulness of potash as most striking in *scrofula* affecting persons of a soft but full muscular system, and a torpid phlegmatic temperament. He prescribed a solution of one draehm of the alkali in an ounce of distilled water, of which two drops were given twice a day, to young children, and the dose gradually increased.² Pereira says: "I have seen the liquor potassa remarkably beneficial in excessive enlargement of the lenticular or glandular papillæ at the base of the tongue."

Frank prescribed the alkaline solution successfully in a case of excessive *tympanitis*, probably of that sort which arises from an acid state of the secretions in the alimentary canal. Blane employed it in *dyspepsia*, accompanying a similar state of the digestive organs. The same author speaks³ of the utility of alkalies in general in the treatment of eruptions of the face, and particularly in *gutta rosacea*, which is so apt to be associated with calculous disorders. He also refers to a remark of John Hunter, that the use of the caustic solution internally is a very effectual cure for *boils*. In other skin diseases this alkali is less commonly prescribed than soda.

ADMINISTRATION.—Various preparations of potassa are employed as *caustics*. The most common is the hydrate of potassa, called *caustic potassa*, but the composition known as *potassa cum calce* is less deliquescent and is also milder in its operation, and therefore more manageable. The preparation called *Vienna caustic* is composed of equal parts of potassa and lime, and is preserved in the form of a powder, which must be made into a paste with alcohol before being used. It is still milder than the before-mentioned preparations. One of the most convenient forms in which caustic potash can be employed is that devised by *Filhos*, and which is made by fusing together two parts of potassa and one of quicklime, and casting the liquid in cylindrical moulds.

¹ RICHTER, op. cit., iii. 500.

² Op. cit., i. 188.

³ Dissertations, 203, 204.

It is very hard and extremely powerful, and may be protected from the air by a suitable coat of varnish, or of sealing-wax. To produce an eschar by means of either of these preparations, the part to be operated upon is covered with a piece of adhesive plaster in which an aperture is made of the size of the intended issue. A small piece of caustic, or a portion of its paste, is laid upon the exposed part and allowed to remain, the former twelve hours, and the latter from five to fifteen minutes. Or the part may be daily rubbed with the solid caustic, and, in the interval, be covered with a poultice. If the caustic spread beyond the intended limits, its action may be checked by vinegar and water.

The solution of potassa may be administered *internally* in doses of from ten minims to a fluidrachm, its effects being carefully watched meanwhile. It is recommended to be given in veal broth, or in table beer, but these vehicles are thought to be objectionable, the one by converting a portion of the medicine into soap, and the other, if sour, by neutralizing it. A sweetened aromatic infusion is perhaps preferable to either.

SODÆ CARBONAS.—CARBONATE OF SODA.

SODÆ BICARBONAS.—*Bicarbonate of Soda.*

DESCRIPTION.—The carbonates of soda now used in medicine are exclusively the products of chemical processes. The *carbonate* is obtained by adding sulphuric acid to sea salt, and decomposing the sulphate of soda which results by means of ground chalk and small coal. This impure preparation is then lixiviated, and subsequently roasted in a reverberatory furnace, along with coal-dust or sawdust. It is further purified by being redissolved and strained, after which the solution is allowed to crystallize by evaporation. The *bicarbonate* is prepared artificially by saturating a concentrated solution of the carbonate of soda with carbonic acid. A partially pure or caustic *hydrate* of soda may be obtained by a method similar to that employed for caustic potassa. But the latter preparation is used to the exclusion of the former.

The carbonate of soda found in commerce is in the form of prismatic crystals, which are transparent, colorless, and have a strongly alkaline and even caustic taste. It contains nearly two-thirds of its weight of water. When heated, it dissolves with ebullition, and by exposure to the air rapidly effloresces. This salt is soluble in twice its weight of

water, and, in dissolving, greatly reduces the temperature of the liquid. It is insoluble in alcohol. The bicarbonate or sesquicarbonate of soda is sold in the form of a white powder or in small scales; it is almost tasteless, but has a somewhat alkaline savor. It does not change by exposure to the air, and is but slightly soluble in water, requiring thirteen parts of lukewarm water to effect its solution.

HISTORY.—The history of the native carbonates of soda, known to the ancients, is enveloped in much obscurity, for the qualities attributed to them by early writers do not clearly belong to these salts. The names of natron, natrum, and nitrum, are those by which the substances in question were known. The *natron* of the ancients is thought to have been a native mixture of the subcarbonate, hydrochlorate, and sometimes the sulphate of soda,¹ and Pliny is supposed to have confounded under the name of *nitrum* the subcarbonate and the nitrate of potassa, and the subcarbonate of soda.² The late Dr. Mitchell, of New York, mentions in his essays some facts which diminish the confusion of this subject.³ According to him, the true oriental nitre was soda, and was a native mineral alkali. In course of time it was found that the ashes obtained from the incineration of the beech, oak, and other trees, might be employed instead of the original or native soda. Hence, potash came also to be called nitre, and when the combination of it with nitric acid was found in nature, that also received the name of nitre, which it still retains.

Pliny describes the several sources from which nitrum was obtained, as natural springs and lakes, the soil, and certain caves. It abounded especially in Egypt, where it was used in the processes of embalming.

Carbonate of soda exists in certain marine plants, of the genus *salsola*, from which it may be obtained by incineration, but in an impure state. The sodas of Alicant, Carthage, Malaga, and Sicily, furnish the largest proportions of pure alkali. The *sesquicarbonate* of soda is found in solid, hard, striated masses near Tripoli, in Africa. The natives call it *trona*, a name which may very probably be a corruption of *natron*. A soda of very nearly identical composition has been discovered near Merida, in South America. There is a native *subcarbonate* of soda in Hungary and in Egypt, where it exists in the form of an efflorescence of fine, acicular crystals, mixed with chloride of sodium, and also in the mud of certain lakes.

According to Pliny,⁴ in a chapter on sponges, the ashes of these bodies, which contain a large proportion of soda, may be usefully

¹ MÉRAT and DE LENS, Dict. cit., iv. 584.

² Ibid., vi. 394.

³ Med. Repository, v. 119.

⁴ Hist. Nat., xxxi. 47.

employed for granulations of the eyelids, for fleshy excrescences, and, in a word, for all cases that require deterative, fortifying, and stimulant applications. This author also speaks¹ of *nitrum* as caustic, astringent, and deterative, as useful in papular and pustular cutaneous eruptions, for repressing excessive perspiration, removing specks from the cornea, whitening the teeth, and destroying vermin on the skin; he prescribes it in an ointment for the bites of dogs, with vinegar and lime for the bites of serpents, and as a dressing for phagedenic and gangrenous ulcers. He also recommends a solution of it for correcting the unpleasant odor of the armpits, baths containing it for gout, for tetanic spasms, &c. Galen² speaks of soda as being in daily use for the purposes of ablution—in baths, &c.—as well as for the cure of cutaneous affections. Dioscorides enumerates a great many uses, besides those already mentioned, in which this substance is useful, but they are of questionable importance. Avicenna speaks of its use in eruptions of the scalp, and attributes to it vermifuge properties, as well as a tendency, when taken habitually, to weaken the digestion.

ACTION.—Many writers regard the medicinal qualities of the carbonates of soda as so nearly identical with those of potassa, as to treat of them all under the same head. But there are real and important differences between them. The carbonates of soda are less apt to derange the stomach, because, it may be, that they belong to the natural constituents of the body; on the other hand, the carbonates of potassa are more readily eliminated by the kidneys, and are therefore preferable when the action of the remedy is to be confined more particularly to the urinary organs.

Carbonate of soda, in large doses, is irritant and corrosive, but by no means so much so as the carbonate of potassa. As a poison it has no remote action, except what arises directly from the local injury inflicted. Its antidotes are fixed oils, vinegar, lemon-juice, or any preparation containing an excess of some vegetable acid, particularly the acetic, citric, and tartaric. In large doses it is diuretic, but less so than carbonate of potassa. Like that salt, it passes off by the kidneys, rendering the urine alkaline. "Some," says Dr. Christison, "have thought that they observed injurious consequences from the long-continued use of alkaline carbonates in gravel and acidity of the stomach; and diseases of the kidneys, as well as organic disorders of the stomach have been referred to the practice. These suppositions are probably imaginary. There can be no question that many have used alkaline remedies habitually throughout a long life, without in-

¹ Hist. Nat., xxxi. 46.

² EBN BAITHAR, op. cit., i. 188.

jury." This statement is undoubtedly too absolute. The occasional deleterious results of a protracted use of alkalies have been pointed out under the head of Potassa, and are supported by the testimony of too many authors for us to call them in question.¹ But while insisting on the reality of the danger, it would be unfair to exaggerate it. The state of the economy has doubtless a determining influence upon the salutary or evil influence of alkaline remedies. As M. Mialhe has pointed out, the principal animal fluids are themselves alkaline in health, but, owing to certain habits of life, such as the sedentary occupations and animal diet among the inhabitants of towns, the excretions are very imperfectly performed, and a great deal of acid which ought to be eliminated is retained within the system. Where these conditions, therefore, exist, a very large amount of alkaline ingesta is required to neutralize the retained acids; and, on the other hand, an active and laborious life, and a diet composed in greatest part of vegetable food, render the toleration of alkalies more difficult. In like manner diseases in which there is an excess of acid in the humors, such as gout, gravel, and diabetes, permit a very large amount of alkalies to be taken, not only with impunity, but with advantage, while the so-called "putrid" affections are uniformly aggravated by these medicines. In fact, if their mode of action be correctly understood, they would seem to be contraindicated in all cases of exhaustion and debility.

REMEDIAL EMPLOYMENT. *Dyspepsia*.—In some forms of dyspepsia the most striking symptom is acidity of the primæ viæ. The conditions out of which they arise may be thus described.² The acidity in question may have its source in the acetous fermentation of amylaceous and saccharine food, the ingestion of sour substances, the development of carbonic acid gas in the bowels, an excessive formation of fatty acids resulting from the use of too much oleaginous food, and finally, a supersecretion of the normal acids of the stomach. Under all of these circumstances the carbonates of soda are especially indicated. The symptoms which are produced by an undue amount

¹ Vid. TROUSSEAU (Journ. de Méd., 1846, p. 65) ; and BOUCHARDAT (Annuaire de Thérap., 1847, p. 120 et seq.), who gives a caution against the use of alkalies even for acidity of the stomach, for while he admits that their immediate benefits are certain, he at the same time insists that they expose the patient to serious risk by exciting an excessive secretion of the very acid they were destined to counteract. The same writer insists upon their operating as a cause of sudden death by augmenting the liquidity of the blood, and thus predisposing to apoplexy, or sometimes to engorgement of the lungs. He further states that, having witnessed sudden death in two diabetic patients overdosed with alkalies, he believes that an abuse of the bicarbonate of soda had its share in the fatal result.

² KISSEL, Naturwiss. Thérap., p. 107.

of acid in the stomach are not clearly determined, but the most certain are sour eructations, vomiting, and dejections, with heart-burn. Sometimes the tongue is thickly coated, but when the acidity is extreme, the tongue is clean, intensely red, and even shining, and very sensitive. The appetite is capricious, the mouth dry, and there is a sense of fulness at the præcordium. But gastric acidity is often connected with general disorder of the system, with anæmia, for example, and then, although soda may, for a time, correct it, the symptom speedily returns, and especially after the use of food containing starch or sugar. In this form of the complaint the use of alkalies, although it may for a time correct the acidity of the stomach, ultimately aggravates the evil, and still further impairs the constitution.

The form of dyspepsia which is connected with hypochondriasis sometimes finds relief in the use of soda, and especially in a full dose of the medicine taken directly after meals. In this affection the most prominent indication for the alkaline treatment is the occurrence of abdominal pain after eating. As soon as it has ceased the medicine should be suspended lest its general influence on the system prove injurious. In almost all cases in which alkalies are used for the purpose of neutralizing acids in the primæ viæ, the proper time for their administration is either with the food or after eating, for physiologists inform us that when the stomach is empty its secretions are but slightly acidulous.

Many ailments of young children arise from the ingestion of sour milk, or the generation of acid in the bowels. The little patients are restless, wakeful, and cross; they scream frequently, and especially after eating, their sleep is disturbed, they vomit curdled and sour milk, and by the retraction of the lower limbs show that they suffer from colic. In general the dejections are frequent, sour, and greenish, and consist of a thin liquid containing small fragments of yellow fæces resembling portions of hard-boiled eggs, or sometimes spinach and eggs finely hashed together. If the child is fed artificially, soda can be mixed with its food, or if it is still nursing, a solution of soda in some aromatic water may be administered, and in either case the addition of prepared chalk assists in moderating the diarrhoea. M. Trousseau states that at the Necker Hospital he succeeded in diminishing the rate of mortality among the young children by adding about ten grains of bicarbonate of soda to each quart of milk given them. This expedient has the further advantage of delaying for many hours the curdling of the milk intended to be used.

Lithiasis.—Soapmaker's lye was at one time extensively employed in calculous affections, and various secret remedies for such disorders have

turned out to consist essentially of soda in some of its combinations. The value of this alkali and its carbonates is chiefly shown in cases of lithic acid calculus and gravel. It is generally regarded as operative by means of its chemical affinities which are supposed to effect a solution of the concrete acid, but some have held that it is chiefly by promoting the flow of urine that it produces the discharge of sabulous concretions. No doubt that both modes of action contribute to the result. However this may be, it is certain that during the administration of soda the growth of acid concretions must be suspended, since the precipitation of their elements from the urine is prevented. So thoroughly, indeed, are the chemical conditions of this fluid changed, that from being acid it may become alkaline, and even deposit a coating of the latter nature upon the original calculus. Not a few writers testify to the complete cure of acid urinary concretions by means of soda, and some even maintain that these bodies may decrease in size, grow softer, and be discharged under its influence. This may unquestionably take place when the calculus is soft, or is composed of a congeries of particles held together by animal matter, which is soluble in alkalies. A remedy of secret composition enjoyed considerable reputation in the treatment of stone, during the last few years in England. It was called "Constitution Water," and appeared to be essentially an alkaline solution. Dr. Golding Bird vouched for its success in cases of uric acid gravel, and stated that he was himself in the habit of using with very great advantage in cases of pisiform uric acid gravel a solution containing from two to four drachms of bicarbonate of potassa dissolved in thirty or forty ounces of water, in the course of twenty-four hours. Mr. Bulley also reports a case of stone terminating, as it would seem, in perfect cure under the use of the carbonate of soda.¹ One of the best forms for its administration is that of soda water, described below. The highly carbonated state of this liquid averts the danger of substituting alkaline for acid concretions in the urinary passages. Indeed, according to Christison, it exerts a curative influence in cases even of the phosphatic diathesis, by maintaining the earthy phosphates in solution.

Some writers will have it that the antilithic powers of soda are by no means exclusively confined to a neutralization of liquid or concreted acid in the system, but that it also prevents the morbid secretion of acid for a long time even after the medicine has ceased to be taken. Although, as has been elsewhere stated, the disappearance of acid concretions from the urine may be merely the sign of a chemical dissolu-

¹ Med. Times and Gazette, June, 1853, p. 600.

tion of gravel retained in the urinary passages, or the effect of diuresis produced by the medicine, and not of such a change in the action of the system as arrests the production of gravel, it may nevertheless be possible that alkalies have a power of permanently suspending the calculous formation. But the evidence in favor of such a power is thus far incomplete.

It has been supposed, as already intimated, that soda is more acceptable to the stomach than potassa, and for the reason that the former enters more largely than the latter into the composition of the animal economy. But it is by no means settled that the assertion on which this explanation rests is true in point of fact. Not a few writers maintain the contrary, and one of the most judicious, Blanc,¹ uses this language: "As far as I can judge of the comparative powers of the two alkalies, I should greatly prefer potash to soda for the cases in question. One reason of this may perhaps be that soda is an element of the animal fluids, as it enters largely into the composition of the bile, so that it is more likely to be arrested in the course of the circulation, and diverted from the urinary organs."

Gout.—The use of soda and of alkaline remedies generally in chronic gout has been highly extolled by various writers. (*Vid.* Potassa.) The mineral waters of Vichy, in France, which contain a large proportion of soda, are perhaps the most renowned as a remedy for this disease. M. Rilliet, who examined the subject carefully,² concludes that these waters are a precious, if not a specific, remedy for gout, but he greatly weakens the value of this conclusion by the statement that thermal saline waters of all sorts have a similar efficacy.

Diseases of the Skin.—Alkaline medicines and baths were recommended by Willan and other English writers on cutaneous diseases. The latter form of administration, which has since been so extensively used upon the continent of Europe, was introduced into the Parisian hospital of St. Louis by Biett. In this country it is believed that there is no systematic employment of these and other methods for the cure of skin diseases in any of the large hospitals. The baths used by Biett were at a temperature of about 80° F., and each contained from four to sixteen ounces of carbonate of soda. The patient remained in them for an hour.³ By the use of such baths, if the skin is not inflamed, or is in a state only of chronic inflammation, it grows warmer, swells somewhat, and gradually its layers become more permeable, and resolution of the disease takes place. If the surfaces are red and inflamed, the alkali sometimes aggravates their irritation if its

¹ Dissertations, p. 188. ² Archives Gén., Jan. 1844. ³ Bull. de Thérap., vi. 296.

full action is allowed.¹ On this account, a much weaker solution than that used by Biett should be employed, and the action of the water may still further be tempered by the addition of mucilage, or of bran. Alkaline baths are found most efficient in the several forms of *lichen* and *prurigo*, and in dry, *scaly* eruptions. Cazenave speaks of them as almost the only certain remedy for that form of *prurigo* to which children are subject, and which is so distressing in its effects, both upon body and mind. Indeed, the existence of itching is the prime indication for the use of these means. In *pustular* eruptions, and in tubercular *elephantiasis*, they would seem to be of inferior utility; but when in the former the crusts have grown thick and hard, and the inflammation of the skin is not active, they have a prompt and powerful effect. In *eczema*, alkaline baths are uniformly injurious if the eruption is in a state of activity and the solution strong; but when the inflammatory symptoms decline, baths of a weak solution of soda, in which bran is allowed to infuse, forms one of the most soothing of applications in this tormenting malady. The same method is highly useful when the skin has become thickened by successive eruptions of the disease.

Alkaline lotions are very useful in cleansing portions of the skin upon which ointments have been applied, and the hairy scalp in particular. As a curative agent, also, for *herpes circinatus* of the thighs, in its declining stage, for *lichen agrius* of the calves of the legs, for nummular lichen of the hands, and for *intertrigo* of the thighs, breast, and armpits, these lotions have been recommended by Dévergie.²

Carbonate of soda, in solution, may be employed to allay the itching of *pruritus of the vulva*, but is less effectual than the biborate of soda, or than the salts of mercury.

When given internally, the effects of carbonate of soda upon diseases of the skin are not at first very marked, yet in daily doses, of from two to four drachms, it generally produces a decided modification in the eruption. This at first consists merely of some alleviation of the itching, which gradually becomes less constant and severe. If now the remedy is continued, an unusual heat is felt in the skin, in *prurigo*, for instance, and this often ushers in a more or less complete resolution of the inflammation. Cutaneous eruptions are not unfrequently connected with acidity of the *primæ viæ*, and when such is the case, soda is clearly indicated, whatever the state of the external disease may be.

Tumors.—Soda has been much employed as a resolvent for hypertrophied glandular organs, but, since the discovery of iodine, much

¹ CAZENAVE, Bull. de Thérap., iii. 109.

² Ibid., xxix. 84.

less frequently than formerly. Pesehier recommended it for goitre, and in scrofula it was found successful by Farre, Dzondi, Otto, and others. It is very probable that the soda employed by these writers was the variety obtained from the ashes of sea-weed, and that it contained a proportion of iodine. Engorgement of the liver appears to be favorably influenced by soda when it arises from the malarious influences of warm climates, or from overfeeding, particularly if the affection is not of long standing. The waters of Viehy, in France, and of Schlangenbad and Ems, in Germany, are much resorted to for the relief of these affections.

Fevers.—The treatment of idiopathie continued fevers, by means of alkaline medicines, was brought into vogue, a few years since, by Dr. Stevens, who advised them to be used in combination with salines, but, indeed, held them to be subordinate to these latter. Dr. Copland, in speaking of typhoid fevers, says that the carbonates of soda and of potash “are preferable in the latter and middle stages, more especially when the blood appears morbid, the skin discolored, and the excretions offensive.” This treatment, however, does not appear to deserve much confidence. It is a method originating as the offspring of a theory, and, like its parent, has now fallen into general discredit.

Rheumatism.—The use of lemon-juice in the treatment of rheumatism was introduced, a few years ago, by Dr. G. O. Rees, and, according to Dr. G. Bird, its effects and those of carbonate of soda, upon the system, are intrinsically the same. The former of the two agents is essentially a supereitrate of potassa, and although this salt and the acetate of potassa are perhaps more promptly effectual, the carbonates of soda are but little inferior to either of them in the treatment of acute rheumatism, and may, it is believed, be advantageously employed in the absence of other remedies.

ADMINISTRATION AND DOSE.—Carbonate of soda is administered internally in solution. One of the best forms for its administration is that of soda water (*Aq. Carb. Sodæ Acidula*), or water strongly impregnated with carbonic acid, and holding in solution at least two scruples of the salt to every pint of water. The dose of either carbonate of soda is from ten grains to half a drachm. M. Trousseau states the daily dose of the simple carbonate as from half a drachm to one ounce. Soda may be advantageously combined with tonics in many instances, and particularly with vegetable infusions of a stimulant and tonic character. But in all cases the solution should be very weak, for otherwise, the admixture of the soda with the saliva in the mouth tends to develop ammonia, and to excite a strong repugnance to the medicine. Soda lozenges (*Trochisci Sodæ Bicarbonatis*) are convenient and useful in cases

of habitual acidity of the stomach. From two to eight ounces of the carbonate may be used in a general bath for diseases of the skin. A lotion, for the same purpose, should contain fifteen or twenty grains to the ounce of water for scaly affections, and about half that proportion for lichenoid eruptions. A solution of the latter strength is appropriate as a wash for the mucous membrane of the female genital organs.

SODÆ BORAS.—BORAX.

DESCRIPTION.—Native borax, known by the name of *Tinkal* (Tan-kâr), is extracted from the earth in Persia, China, Thibet, and Japan, or is gathered from the shores of certain lakes. It is also found in two mountainous districts near Potosi. From the waters of the lakes alluded to it is also procured by artificial evaporation. As thus obtained, borax is in a very impure condition, being mixed with clay and a fatty substance which the alkali of the borax converts into soap. It is then of a bluish or yellowish color. The method of purifying borax was for a long time a secret of the Dutch and Venetians; but various methods were afterwards employed for this end, of which solution in hot water, exposure to heat, and mixture with soapsuds, were the principal. But in 1776 a new source of supply for borax was discovered in certain warm springs of Tuscany. The waters of these springs, which contain a large proportion of boracic acid evolved by volcanic agency, are artificially combined with soda by being mixed with the carbonate of this alkali.¹

Borax is generally met with in the form of oblique prismatic or octohedral crystals. When impure, they are small, opaque, of a greenish color, and a greasy feel; but when purified by repeated solution, they are large, white, semitransparent, and shining. Their taste is sweetish at first, but is afterwards alkaline and bitter. By friction together in the dark they become luminous. They effloresce slightly by continued exposure to the air. Borax has a feeble alkaline reaction, does not effervesce in acids, and, when exposed to a moderate heat, it parts rapidly with its water of crystallization, and swells up into a white, porous, and friable mass. At a higher temperature it is vitrified. It is soluble in twelve parts of cold and in two of warm water. Borax has the singular property of inspissating a solution of gum Arabic, of salep, or of Iceland moss. Even two or three grains of it are enough to convert half an ounce of gum mucilage into an elastic mass, which, however, may be liquefied again on the

¹ SACHS and DULK, Handwört., i. 623.

addition of honey or sugar to the mixture. When mixed with cream of tartar, it renders this salt soluble.

HISTORY.—This substance is supposed to be described by Pliny under the name of *Chrysocolle*.¹ According to this author it is used as a vulnerary when mixed with wax and oil, and serves to dry and constringe wounds when applied to them in powder. It is used, he says, with honey for sore throat and for orthopnoea. It also acts as an emetic. It enters into collyria for removing opacities of the cornea, and into anodyne plasters and those intended to efface scars. Galen and Dioscorides ascribe to it virtues of the same kind. The Arabians, who named it *Tankâr*, also speak of its eleansing and astringent powers, and one of their number recommends it for toothache caused by caries.²

ACTION.—Owing to its therapeutical relations, borax may be classed with the alkalies, and especially with soda. From its effects when applied externally, it may be inferred to possess a local sedative influence upon morbid action in the nervous and vascular systems, which, however, it exerts, like many other agents, by previously stimulating the tissues to which it is applied. When taken internally it does not disturb the digestion as much as the alkalies do. Wibmer took six drachms at a dose without any ill consequences beyond a temporary oppression at the stomach.³ It is said to have a tendency to dissolve the blood and augment the secretions without exciting the circulation. According to Wibmer, the emmenagogue virtues of borax were known to the ancients, and, as will be seen in the sequel, modern observation is not wholly at variance with their belief. Vogt⁴ speaks of its being particularly celebrated for these qualities, and not only for promoting menstruation, but also for moderating the cramp-like pains which often attend this process when it is irregular, for regulating the uterine contractions during labor, and for strengthening feeble pains. Some writers have not hesitated to ascribe such virtues to borax upon no other ground than because its administration of this medicine in conjunction with *ergot* was followed by uterine contractions! According to Vogt, narcotic powers have also been ascribed to this medicine.

USES. *Externally.*—Borax has been much employed as a *cosmetic*. It is asserted to have the power of removing freckles and other accidental discolorations of the *skin*.⁵ Hufeland recommends a wash com-

¹ Hist. Nat., xxxiii. 28.

² EBN BAITHAR, Heil- und Nahrungsmittel, i. 214.

³ Wirkung der Arzneim. u. Gifte, v. 51.

⁴ Pharmakodynamik, ii. 587.

⁵ RICHTER, Ausfür. Arzneim., iii. 558.

posed as follows: R.—Sodæ borat. ℥ss; aq. flor. aurant., aquæ rosæ, āā ℥ss, as one of the surest and at the same time most innocuous remedies for liver marks (*chloasma*), and those exanthematous spots which afflict young women of a plethoric habit, particularly at the menstrual periods. The discolored skin should be bathed thrice or four times a day with the solution, which should be allowed to remain upon it until it is dry. The same method is also recommended for that unseemly redness of the nose which proceeds from a similar cause. *Chilblains* are said to be relieved by a salve containing two drachms of borax to an ounce of cold cream. A wash composed of one drachm of borax to two ounces of distilled vinegar has been recommended by Abercrombie and by Christison as an excellent lotion for *ringworm of the scalp*. It has also, according to Pereira, been found serviceable in *pityriasis versicolor*, and Richter used a solution of it with advantage for removing *opacities of the cornea*. It is often employed in ill-conditioned *ulcers* of the skin and mucous membranes. When first applied it occasions a moderate sense of burning, but it quickens the reparative processes, cleanses foul and flabby surfaces and causes them to granulate. Although borax has no power of controlling mercurial *salivation*, it is nevertheless a most excellent agent for healing the ulcers which this state induces, and for strengthening the spongy gums. For this purpose it is well to associate it with tincture of myrrh, as in the following formula: R.—Sodæ bor. ℥ij; aq. rosæ ℥vij; mel. despumat., tr. myrrhæ, āā ℥ss.—M.

One of the most ordinary uses of borax is to remove the aphthæ which affect the mouth, fauces, and anus of nursing-children, and which appear to be caused by an undue generation of acid in the primæ viæ. The medicine may be administered internally in doses of from three to ten grains a day, according to the child's age, and associated with magnesia in some aromatic solution, while the mouth is at the same time frequently coated with a paste composed of honey and borax, or of the latter with honey of roses or with a thick solution of gum Arabic and sugar.¹ Dewees prescribed, as the best agent for the purpose he had ever tried, equal parts of borax and loaf-sugar rubbed to a fine powder, of which a small quantity, in its dry state, was directed to be thrown into the mouth every two or three hours.² The latter is a more stimulating application than those previously mentioned, and should not, therefore, be preferred when the parts are extremely sensitive.

An aphthous condition of the mucous membrane of the *vulva* and

¹ RICHTER, loc. cit.

² Dis. of Children, p. 309.

vagina, and which sometimes occurs in adult females, and is a source of extreme annoyance and suffering, may almost certainly be cured by a watery solution of borax. Excoriations of these parts are healed by the same means, as well as superficial ulcers of the mouth and fauces, spongy gums, fissures of the nipples, &c. For the latter Richter recommends the following: R.—Sodæ bor. ʒj; alb. et vitell. ovi, āā ʒij a ʒiij; ol. amyg. ʒj; bals. Peruv. ʒiss.—M. S.—Apply to the nipple on charpie.

Internally.—Richter regards it as indubitable that borax possesses a power of stimulating the *inert uterus*, exciting its secretion, and promoting its contractions during labor, and consequently deserves to be ranked with *emmenagogues*. Wedel, Stark, Lentin, Hufeland, Lobstein, and others, about the close of the last century recalled attention to this almost forgotten property of the medicine. According to them, it is indicated in scanty and suppressed menstruation connected with plethora and a morbidly sensitive condition of the nervous system. The dose employed was ten or fifteen grains three times a day. Wibmer¹ vouches for the reality of this virtue, and states that he gave to a female, whose menses were regular but scanty, a drachm of borax in sweetened water. During the night she was seized with severe cramps in the lower belly, and the discharge came on several days before its proper time, but was not more abundant than before. Dr. Stahl, of Vincennes, Ind.,² highly extols the efficacy of borax in the treatment of dysmenorrhœa, particularly in persons of a sanguine constitution. But the venesection and cooling laxatives he employed conjointly with the borax, deprive this latter of much credit for the result. Many authors have recommended it as an *ecbolic*. How far its power has been deduced from observation may be inferred from the statement already made above, and from that of Kopp, who asserts that when labor pains slacken, four or six grain doses of borax, given every quarter or half hour, will often arouse the expulsive efforts of the uterus, and terminate the delivery. Sundelin, however,³ testifies, upon the ground of his personal experience, to the efficacy of the medicine in terminating difficult and irregular labors.

Borax has also been used as a *lithontriptic*. It renders the urine alkaline, and is said to dissolve lithic acid gravel and calculi.

ADMINISTRATION.—The dose of borax, when given internally, varies from a few grains to a drachm.

¹ Wirkung, &c., loc. sup. cit.

² Am. Journ. of Med. Sci., xx. 536.

³ Heilmittellehre, i. 194.

CALX.—LIME.

AQUA CALCIS.—*Lime-Water*.CALCIS CARBONATES.—*Carbonates of Lime*.

FORMS AND PROPERTIES.—The properties of these several forms of lime are so nearly alike, as respects their internal action and uses, that they may be advantageously considered together.

Lime is never found pure in nature. It occurs, however, in combination with a variety of acids in all three of the kingdoms of nature. It is prepared by calcining, with a strong heat, some form of the native carbonate. As thus obtained, it is a grayish-white solid, which readily disintegrates on exposure to the air by absorbing carbonic acid and water. It is very refractory in the fire, having been fused only by the compound blowpipe of Dr. Hare.¹ It has a strong caustic and alkaline taste, and, when moistened, a peculiar odor. Upon adding to it about half its weight of water, it cracks and falls into powder with the evolution of heat enough to inflame sulphur. A larger proportion of water reduces it to a paste or mortar, which, by the evaporation of the liquid, grows exceedingly hard; a still larger proportion forms the solution known as lime-water.

Aqua Calcis, or Lime-water.—A striking peculiarity of lime is that it dissolves in cold more readily than in hot water. At 60° F. this liquid dissolves one seven-hundredth of its weight of lime, but hot water takes up only one twelve or thirteen-hundredth part of lime. Hence, when lime-water is heated it becomes clouded, and a deposit of lime takes place. It is a perfectly clear and transparent liquid, inodorous, and with an astringent and somewhat alkaline taste. It changes vegetable blues to green, and produces an imperfect soap with oils. A pellicle of carbonate of lime forms upon its surface when it is exposed to the air, which afterwards subsides, while a new one takes its place. Thus by degrees the whole of the lime in the solution is exhausted.

Calcis Carbonates (Carbonates of Lime).—One of the most common of these is *chalk*, which, as a native carbonate, exists in great abundance in the South of England and in the North of France, as well as in many other countries of Europe. The microscope shows it to consist of the shell-cases of marine insects. It is used in chemistry and pharmacy, but not in medicine until it has undergone the process of levigation

¹ U. S. Dispensatory.

and elutriation. It is then called *prepared chalk* (*Creta præparata*). Other medicinal varieties of carbonate of lime are derived from the animal kingdom. These are: 1. *Testa, prepared oyster-shell*, which, although obtained by calcination, contains a variable proportion of animal matter. 2. *Lapides Cancrorum*, or *Oculi Cancrorum* (*crabs' stones*, or *crabs' eyes*). These are small calcareous concretions formed in the stomach of the crawfish (*Astacus fluviatilis*) at the time when the animal is about to change its shell. They are smooth and button-shaped, with a depression in the middle of the concave surface, surrounded by a ring, which gives them some likeness to an eye, and suggests their popular name. They also contain some animal matter and phosphate of lime. In this country they can rarely be had genuine. 3. *Chele Cancrorum*, or *crabs' claws*, a preparation made by grinding the claws of *Cancer pagurus*. 4. *Corallia* (*corals*), red and white. The latter two varieties are now obsolete in medicine, although the last one is still employed to make a dentifrice, for which purpose also carbonate of lime obtained by precipitation is employed.

MEDICAL HISTORY.—Hippocrates recommended milk of lime or lime-water as a remedy for leprous affections.¹ Dioscorides describes three varieties of lime, one made from sea-shells, another from certain pebbles, and a third, which he says is the best of all, from marble. He mentions its hot nature, and its use as an escharotic, and also that when mixed with fat or oil it is maturative, emollient, resolute and healing. Galen describes it in the same terms, and adds that it loses its caustic quality in some degree by exposure to the air, and altogether by the addition of water, but continues to be powerfully desiccative.² Pliny gives a similar description, adding that, when mixed with vinegar and honey of roses, lime promotes the healing of serpiginous ulcers.³ In 1808, Sir H. Davy proved it to be the oxide of a metallic base, to which he gave the name of calcium.

ACTION.—*Quicklime* (*Calx viva*), or unslaked lime, produces a rapid decomposition and destruction of organized matter. In this manner it serves as a valuable manure, causing the solution of all vegetable and animal matters in the soil. Hence it is habitually used to purify cess-pools, dissecting-rooms, &c., and is placed in graves when it is desirable to destroy the dead body rapidly, and on a large scale it is employed on battle-fields. Tanners make use of it to separate the hair and cuticle from skins. In its local action, quicklime resembles the pure alkalies, but is less energetic, owing, probably, to its inferior affinity for moisture. It is caustic, however, when taken internally and in

¹ Ed. Van der Linden. i. 708.

² MATTHIOLI Comment., v. 91.

³ Lib. xxxvi. 67.

large doses, occasioning vesicular inflammation of the mouth and fauces, heat, pain, and inflammation of the stomach, and sometimes ulceration and gangrene of this organ and of the œsophagus, with fever, thirst, bloody stools, extreme anguish, and even death.¹

Lime-water differs from the solutions of the alkalies in being destitute of caustic properties. On the other hand, it has a powerful astringent and styptic operation. Hence, even in overdoses, it never disorganizes the animal tissues. Its astringency is not shown by a contraction of the parts to which it is applied; it appears rather to control their secretory action, rendering them dry and pale. Even Dioscorides noticed this drying quality of the medicine, which has also been designated in the same manner by Vogt and other modern authorities. When absorbed, lime-water has a similar effect upon the glandular organs, diminishing their secretions in a remarkable degree. Its habitual use is therefore apt to be hurtful as well by neutralizing the acids of the primæ viæ as by arresting their habitual mucous secretion. A number of writers, particularly of the German school, agree in attributing to lime-water a resolvent action like that of iodine upon enlarged glands, but they appear to have borrowed the statement from some common authority rather than from actual experience. Since, however, the free acids of the stomach must to some extent convert the lime of this liquid into soluble salts which are absorbed, the alleged effects cannot be explicitly denied. According to Vogt,² this preparation exerts a sedative influence upon the nervous system, besides acting as a desiccant, and is therefore analogous in its action to the preparations of zinc.

Carbonates of Lime.—The action of the mineral carbonates does not differ from that of lime-water. Prepared oyster-shells, crabs' eyes, egg-shells, and other testaceous products, contain a certain proportion of animal matter, and are on that account less astringent than the mineral carbonates of lime. In small doses, therefore, they may be used with less inconvenience than these latter; but when administered largely, and for a long time, they entail the same disorder of the digestive organs.

Richter, in noticing the general substitution which has been made of mineral for animal preparations of lime, expresses an opinion that it is an error to have done so, and he calls attention to the fact that the ancients regarded corals as tonic, pearls as diaphoretic and as antidotes in poisoning, &c. Prepared chalk, he remarks, is by no means a substi-

¹ WILMER, *Wirkung*, &c., ii. 5; ORFILA, *Toxicologie*, i. 204.

² *Lehrbuch*, &c., ii. 503.

tute for other cretaceous preparations derived from the animal kingdom, which are more acceptable to the stomach in moderate doses, constipate less, and are more readily absorbed into the system. This writer ascribes a diaphoretic virtue to *crabs' eyes*, alleges that they may produce urticaria, and that they tend to excite hemorrhage. These latter qualities may perhaps be hypothetical; but the belief that the animal carbonates, in general, derange the stomach less than other cretaceous medicines, and are on that account preferable to the mineral carbonates for infants and delicate persons generally, cannot, it is believed, be successfully controverted.

REMEDIAL EMPLOYMENT. *Externally*.—*Quicklime* is a very powerful escharotic. Mixed with sulphuret of arsenic, it has sometimes been used to destroy indolent and unhealthy ulcers, but more frequently as a depilatory. For this latter purpose the orientals are said to apply it to the pudendum, &c., and in Europe it is sometimes employed to remove superfluous hairs from the upper lip and from the bosom in females. When a mixture of two parts of lime with three of water is saturated with sulphuretted hydrogen, a greenish-white jelly is formed, which may be used for the purpose just mentioned by spreading it upon the skin for two or three minutes, and then removing it with an ivory knife. The operation is said to be entirely successful, without producing the slightest pain, or in anywise injuring the skin.¹ Quicklime has also been used to remove congenital nævi. In this case it is mixed with an equal quantity of soap, and applied to the tumor through an opening made in a piece of adhesive plaster, accurately adjusted. The resulting slough separates, and the ulcer which it leaves behind is dressed with some stimulating ointment. It may also be used to establish issues in the same manner, or after that recommended by Mr. Osborne. This consists in placing a small fragment of freshly prepared lime upon the skin, after protecting the adjacent parts in the manner described. A few drops of water are then added. The heat produced is estimated at 350° F., and so rapidly destroys the organization of the skin that the lime ought to be removed before it is entirely exhausted, in order to prevent too deep an eschar. The officinal caustic, *Potassa cum Calce*, is less energetic, but may be used for the same purpose.

Lime-water is often serviceable in pustular eruptions of the skin when they have assumed the chronic form. In *tinea capitis* it has been highly recommended. The scalp should first be cleansed, as far as possible, with soap and water, and the lotion applied to it with a soft brush.

¹ TROUSSEAU and PIDOUX, *Thérapeutique*, i. 360.

In all forms of foul and unhealthy *ulcers*, lime-water is of use both to diminish the discharge and to excite a more wholesome action of the tissues. It also answers an excellent purpose in modifying the condition of the *mucous membrane* of the fauces, auditory canal, vagina, urethra, or rectum, when any one of these passages is the seat of a chronic, mucous, or purulent discharge. The accumulated secretions should first be removed by injections or washes of water or soap and water. It may be very effectually employed to destroy *ascarides* of the rectum. In a case in which these parasites invaded the vagina, causing extreme distress, Richter procured entire relief by means of this remedy. Sir Robert Boyle mentions lime-water and sweet oil, the present *linimentum calcis*, as an excellent remedy for *burns*.¹ Indeed, it was employed by the Greek and Roman physicians for the same purpose,² and is now in general use. It is most appropriate in superficial burns, without destruction of the skin.

The combination of lime-water with calomel forms the well known and useful *black wash*, and its union with corrosive sublimate, the *yellow wash*, of which more will be said under the head of *Mercury*.

Prepared chalk, finely pulverized is often used as a *dusting powder* by females who have a coarse and greasy skin, as well as to promote the healing of *abrasions* of the integument, slight *burns* and *scalds*, *erythematous eruptions*, &c. An ointment prepared with chalk is serviceable in *ulcers* with loose granulations and a profuse discharge.

Internally.—Pulmonary Affections. Several writers attribute decidedly curative effects to *lime-water* in *chronic bronchitis*, with profuse expectoration. If the medicine is absorbed, and actually carried to the anatomical seat of the disease, its curative effects agree with those it exhibits when directly applied to secreting surfaces. The fact of its usefulness is, however, well demonstrated. Even in cases of tuberculous cavities in the lungs, with copious discharge, it lessens the secretion. But, except when the bowels are already the seat of a morbid exhalation, the astringent operation of the medicine upon them may perhaps outweigh its advantage to the lungs, and it should therefore be carefully associated with correctives of its binding quality.

Vomiting. Lime-water is one of the most useful remedies for excessive vomiting, especially when it is administered with an equal quantity of milk. The particular forms of vomiting it is adapted to relieve are not very clearly ascertained, but it may perhaps be said in general to be most successful when there is least inflammation and fever, and when the rejected matters are unusually acid. In certain

¹ Works, SHAW'S ed., iii. 581.

² VOGT, i. 595.

cases of chronic vomiting, which are independent of cancerous disease of the stomach, the combination referred to affords an admirable means of nourishing the patient, while it suspends and sometimes even cures the disease.

Diarrhœa. The various combinations of *chalk* with aromatics, opiates, and astringents, are among the most useful and widely-known remedies for diarrhœa. The cases to which these preparations are adapted, and those which are more profitably treated by purgatives, are not, it is true, discriminated thoroughly, but it may perhaps be laid down as a rule that the former are indicated by signs of gastro-intestinal acidity. Thus, sour eructations, tormina, tympanitic distension of the abdomen, acid discharges, and, in children, greenish stools, are so many signs for the employment of cretaceous medicines. Yet, even here, and except in the heats of midsummer, and in the cases of very young or feeble persons, a laxative ought to precede the use of the astringent medicine. Unless it does so, the diarrhœa will be only temporarily suspended, and the patient will experience great annoyance from distension and pain in the abdomen and sickness of the stomach.

Lime-water is more suitable for the forms of chronic diarrhœa connected with a feeble condition of the alimentary canal. When ulceration exists, it is more apt to be mischievous than useful, except in those cases of chronic dysentery, in which the febrile movement and pain have both terminated. Blane testifies to the eminent usefulness of lime-water "in chronic dysenteries of the lenteric kind."¹ In such cases a diet composed almost exclusively of milk and lime-water, in nearly equal proportions, produces the most beneficial results, and often suffices to complete the cure. Lesser speaks of the successful use of lime-water and milk in arresting the *diarrhœa* of *typhoid fever*, when it continues too long and too copiously.

In *tympanitis* and *flatulent colic* arising from habitual acidity of the primæ viæ, the astringent and alkaline qualities of lime-water are extremely useful in removing the cause of these distressing symptoms in children, and in moderating its influence in adults. With the latter the disorder is a form of dyspepsia, and requires for its removal a strictly regulated diet, and also the association with the lime-water of vegetable tonics and alteratives, such as columbo and dandelion, and occasionally rhubarb and soap to keep the bowels free.

Dewees found great advantage from lime-water and milk in cases of infantile *aphthæ* with green but not liquid stools. He directed a

¹ Dissertations, p. 203.

teaspoonful of the mixture to be given four or five times a day.¹ In such cases, when diarrhoea takes place, prepared chalk is preferable to lime-water.

Stone and Gravel. In 1739 the British Parliament decreed a national reeompense of five thousand pounds sterling, to Mrs. Joanna Stephens for her lithontriptic remedy, which consisted of calcined egg-shells, soap, and several aromatic bitters. This preparation, however, was found so nauseous and so distressing to the stomach, that various substitutes were proposed for it, of which the most simple was *lime-water*. This was suggested by Whytt.² He observed that quicklime had long been looked upon by chemists as containing a powerful remedy against calculus, and he mentioned that the very combination employed by Mrs. Stephens had been commended by Barbette as of incomparable use in all suppressions of the urine from stone and gravel. Whytt gave several instances of its efficacy, one of which was the celebrated Horace Walpole. The sufferings of this statesman were entirely relieved by the remedy, although after his death, which was not caused by calculous disorders, several small stones, and fragments of others, were found in his bladder.³ In like manner calculi were found after death in the bladder of each of the four persons whose cure by Mrs. Stephens' remedy had been officially attested, and which prompted the grant of money already alluded to.⁴ Alston may be cited in favor of the efficacy of this compound in calculous affections. "I found it," he says, "*Dei gratia*, by my own experience, a cure for stone in the bladder, which diminished so much that at last it passed without pain." Soap, which contained a large portion of alkali, was one ingredient of the Stephens' nostrum, so that the antilithic powers of the latter ought not to be attributed entirely to lime.

It cannot be doubted that much of the reputation acquired by lime-water, as a remedy for stone in the bladder, depends upon its astringent quality, by which it allays the inflammatory condition, and blunted the sensibility of this organ. The writings of Gaitshell, Blane, and Whytt, attest the benefits of its use, but the explanation now offered appears to be confirmed by the testimony of Whytt himself, who found the remedy most effectual when it was directly injected into the bladder. Butter also employed this method, which he described in a published essay, and regarded as very successful. He directed the patient to be placed so that his buttocks should be raised, and, after having first thrown muelage into the bladder, injected the

¹ Diseases of Children, p. 308.

² Edinb. Med. Ess. and Obs., 3d ed., v. 2d pt. p. 156.

³ Commentar. Lipsienses, ix. 681. ⁴ ALSTON'S Lectures on the Mat. Med., i. 268.

lime-water twice a day, gradually increasing the quantity. At the same time he administered the medicine by the mouth.¹

What the operation of lime-water in stone may be is not very clearly made out. But it seems to be determined that this liquid has not the degree of solvent power which its original advocates so strongly insisted upon. It more probably renders the mucous membrane of the bladder insensible to the irritation of the stone, and, if judiciously managed, prevents the growth of this body by neutralizing the free acid of the urine. The latter mode of action has been suggested by Blane² and others. Urate of lime is said to be more soluble than uric acid or urate of ammonia (*Christison*); but the reverse is also stated. (*Thurdicum*.) It is alleged³ that lime-water is only suitable to chronic forms of calculous disease, when the patient is free from fever, the bladder indolent, &c. But however just this restriction of its use may be, there can be no doubt that it is a remedy too much neglected at the present time as a palliative for stone, and that, like many other medicines, it has lost credit because it was incapable of performing all that was promised in its name. There is some reason to believe that uric acid gravel may be dissolved and eliminated under its use. How far it may be superior to the carbonates of the alkalies for this purpose, will depend chiefly on the state of the digestive organs. When these are feeble, lime-water is the better preparation.

Chronic *purulent discharges* from the urinary passages are often favorably modified by this remedy, particularly when it is associated with astringent diuretics, as uva ursi, &c. It may also be used by injection.

In *diabetes insipidus*, and even in the *mellitic* form of diabetes, this medicine is said to have been curative. Two cases of the latter are given by Kissel.⁴ In them it was not until several weeks' use of the remedy that the discharge of urine began to diminish; but the subsequent progress towards cure was rapid.

Whytt claimed to have cured *chronic gout* in almost every instance by the use of lime-water.⁵ In the dyspepsia of gouty subjects it is also useful. Clarus⁶ declares the utility of lime-water in cases of *rachitis* and *osteomalacia*, maintaining that it directly furnishes the deficient element. Without positive proof of his proposition, he cites the analogous example of the effect of excluding lime from the food of poultry. The eggs produced by them are unfurnished with a shell. Hence it

¹ Comment. Lipsiensis, iv. 273.

³ MÉRAT and DE LENS, Dict., ii. 24.

⁵ Ed. Med. and Phys. Ess., iii. 459.

² Dissertations, p. 200.

⁴ Naturwissenschaft. Therapie, p. 221.

⁶ Arzneimittellehre, p. 132.

is inferred that the calcareous element of human bones may be supplied artificially when it is deficient.

Many writers allude to the efficacy of lime-water as an internal remedy for *cutaneous affections*, such as gutta rosacea, or those impetiginous affections which depend upon hereditary constitution, or which are connected with calculeous or scorbutic complaints. Blane says that he has seen some remarkable cures of herpetic complaints of the legs by large doses of lime-water, not less than three pints a day. Hoffman also states that he obtained excellent results from the use of lime-water and milk in scurvy produced by salt provisions.¹

When *arsenic*, in a liquid form, has been administered in a poisonous dose, lime-water forms with it an innocuous compound. "In the absence of more appropriate antidotes, lime-water may be administered in poisoning by common mineral and oxalic acids."

ADMINISTRATION AND DOSE.—The dose of *lime-water* is from *half an ounce* to *six ounces*, given from one to four times a day with an equal quantity of new milk, or in weak broth.

The dose of *prepared chalk*, or of the animal cretaceous preparations, is from *five grains* to *two drachms*. It should be suspended in water by the intervention of gum Arabie and sugar.

ARGENTI NITRAS.—NITRATE OF SILVER.

PREPARATION.—Nitrate of silver is an artificial salt obtained by the direct action of nitric acid upon silver. It occurs under two forms. The one (*Argenti nitras*) is in cylinders of about the diameter of a goosequill, of a whitish and afterwards a grayish-white color under the influence of light and exposure to the air, and presenting a radiated crystalline fracture when broken across. This is called fused nitrate of silver, from its having been melted and cast in moulds. The other form is that of colorless, transparent, rhomboidal plates (*Argenti nitratis crystalli*). It is generally a purer salt than the first, and better adapted on that account for internal administration.

HISTORY.—This substance was known to the Arabs in the sixteenth century. Its mode of preparation was described by Angelus Sala (1614), who called it *magisterium argenti*, or *catharticum lunare*. Half a century later it was recommended by Boyle and others under the name of *pilule lunares*. They attributed to it a vermifuge property, and employed it in dropsical diseases and for inveterate ulcers. Boer-

¹ De Scorbuto.

haave informs us¹ that if two grains of this substance are made into pills with crumb of bread and sugar, and taken on an empty stomach, and some warm water with honey is drunk immediately afterwards, it will purge without griping. It had, however, been for a long time neglected when, about the close of the last century, it was employed anew in England and in this country, whence it became generally adopted on the continent of Europe as a remedy for epilepsy and other diseases of the nervous system.² Chapman ascribes its reintroduction into the *Materia Medica* to Sims, of London. Besides the names of the salt which have been mentioned, that of *vitriolum lunæ purgans* was given it by Geoffroy, and it is also known as *lapis infernalis*, *causticum lunare*, *argentum nitratum*, &c.

ACTION. *On Animals.*—Orfila found that even very small quantities dissolved and injected into the veins of dogs produced dyspnœa and choking, followed by convulsive movements of the extremities, and then of the thorax, abdomen, and whole body. Vertigo followed, so that the animal could neither stand erect nor walk steadily, and also retching and vomiting. Death took place with evidences of pain and suffocation. Krahmer³ found that sixty grains dissolved in an ounce of water, and administered to animals, produced no very severe symptoms, and still less caused their death. This dose was given to a dog for four days successively without producing ulceration of the stomach or death. Animals that cannot vomit, such as sheep and rabbits, are, it is true, affected more seriously, and are affected with an inflammation of the stomach which sooner or later destroys them. When a large dose of a concentrated solution has been administered, the gastric mucous membrane is found to be softened and disorganized. Smaller doses produce an intense injection of this membrane, with spots of a grayish or blackish color. This latter alteration is most apt to occur when the poison is taken in substance. In that case, also, there may be perforation of the stomach. The pharynx, &c., may be the seat of similar lesions.⁴

On Man.—Externally. When this substance is applied to a raw surface, or to a mucous membrane, it produces a smarting pain, which lasts for several hours if the part is inflamed. When rubbed upon the skin, so as to cause vesication, it also occasions pain, but less than perhaps any other vesicant. Its contact in any of these cases, but particularly in those first mentioned, produces a white color by a combination of the caustic with the albumen or fibrin of the part; but this color gradually changes to brown, and then to black. The same

¹ LEWIS, *Mat. Med.*, i. 136.

² MÉRAT and DE LENS, *Dict.*, i. 400.

³ CANSTATT, *Jahresbericht*, 1846, p. 246.

⁴ WIBMER, *Wirkung*, i. 216.

effect is produced when the caustic is applied upon mucous membranes. If the rubbing of the skin is prolonged, redness is perceived around the discolored part, and vesication of the latter takes place, but never sloughing, as in the case of acids or of alkaline caustics, and in a few days the blackish film separates at the edges and exfoliates, leaving the skin beneath perfectly sound.

Internally. Heller's experiments¹ show, and they correspond with Orfila's, that neither in the blood nor urine of men or of animals can any trace of nitrate of silver be found, although considerable quantities of it may have been taken. The fæces, on the contrary, appear to contain the whole of the silver that had been administered. This is, however, clearly an erroneous estimate.

Krahmer found that in doses of one-fourth or one-half of a grain no distinctive symptoms were produced, but larger doses occasioned a burning sensation in the stomach, with nausea, malaise, and a peculiar sense of weariness. Diarrhoea is sometimes observed as an effect of large doses. Portal, indeed, ascribed the usefulness of the medicine in epilepsy to its purgative action. Its continued use probably lessens the appetite and the urinary secretion. Bodeley, Lombard, and other writers, ascribed to it a diminished tendency to congestion of the brain in epileptic patients; while Graves observed that when given to persons affected with various diseases, it occasioned vertigo and headache. Portal, indeed, relates a case in which the exciting cause of epilepsy appeared to be a poisonous dose of lunar caustic. Several persons have ascribed to it a tendency to produce hemorrhages. If its use is long continued, it never fails to produce more or less violet discoloration of the skin. When frequently applied to the conjunctiva, it stains this membrane brown.

Krahmer relates a case of poisoning by "*eight drachms*" of nitrate of silver.² The symptoms were insensibility to tactile impressions, and loss of consciousness, with convulsions. The pulse was unaffected. Salt was soon administered as an antidote. In ten hours all parts of the body had regained their sensibility, and the patient was able to speak; but three hours afterwards coma took place, and continued for two hours. On the following days there was a good deal of pain in the epigastrium; but on the sixth day the patient was well. Many examples might be cited in which fragments of caustic have accidentally fallen into the oesophagus, and been swallowed, without injury. To understand these comparatively mild effects of so large a dose of poison, it must be remembered that as the caustic combines

¹ Lond. Med. Gaz., July, 1846, p. 170.

² CANSTATT, op. cit., 1846, p. 247.

readily with albumen, if the stomach contains a sufficient supply of its natural mucus, or of albuminous or gelatinous food, the caustic effect must be in a great degree counteracted. If nitrate of silver is administered in small doses, or associated with neutral substances, its caustic action on the mucous membrane itself must be very slight indeed.¹ Some writers have objected to the name of caustic applied to this salt, on the ground that, unlike potassa, for instance, instead of softening and dissolving animal tissues, it, on the contrary, coagulates and hardens them.

As before remarked, when taken into the stomach it is, after conversion into chloride of silver, as some maintain, carried by the blood-vessels to the skin, and there, by exposure to light, it gives to the integument a violet hue. Others suppose that it is absorbed as nitrate of silver, and is converted into a chloride in the rete mucosum (*Thompson, Delioux*); Patterson and Van Geuns,² however, suppose the chloride to be decomposed by the action of light, and metallic silver to be deposited as the discoloring agent. According to Brandes, it exists in the skin as an oxide; and according to Krahmer, as an albuminate. Butini relates³ the case of an epileptic who had taken altogether five ounces and ten grains of this medicine. His scalp had a grayish-blue color, and his face a dark blue-black tint. Some small scars on the cheeks retained their original color. The mucous membrane of the mouth showed the same change as the skin, but less distinctly. The conjunctivæ were discolored like the face, and the vessels appeared grayish brown. The portions of the body habitually covered with clothing were but slightly tinged. A case is reported by Wedemayer,⁴ of a person who had taken the nitrate of silver for a year and a half, and whose internal organs after death had, all of them, more or less of a bluish tinge. When a blister rises upon skin thus discolored, the contained serum, as well as the cuticle, present their natural color. No means have been found capable of removing this stain, although it has been asserted that diluted nitric acid internally, or iodide of potassium externally, will have this effect. The latter agent, and also the cyanide of potassium, readily efface the stains made by lunar caustic when applied to the skin.

USES. *Internally*.—*Dyspepsia*. Although it has been successfully used in that form of dyspepsia which is attended with gastric pain and vomiting, yet no one before Dr. James Johnson⁵ had clearly described the cases in which it is most appropriate. These are such as,

¹ R. D. THOMPSON, *Am. Journ. of the Med. Sci.*, xxiii. 205.

² *Dub. Quart. Journ.*, Aug. 1858, p. 244.

³ RICHTER, *Ausfür. Arzneim.*, iv. 422.

⁴ DIERBACH, *Neuste Entdeck.*, i. 527.

⁵ *An Essay on Indigestion*, 1826.

in addition to morbid sensibility of the stomach and bowels, present disturbance of the mind and senses, and sometimes of the motory nervous system, to the extent, it may be, of producing convulsive attacks. It was used by Dr. J. in conjunction with bitter tonics, and especially quinia. Autenrieth observed its beneficial effects in dyspepsia following the suppression of a cutaneous eruption, or accompanying a gouty diathesis. Rueff extolled it in the nervous vomiting of children, and Hudson used it successfully in the same disorder. In chronic vomiting accompanied with spasmodic pain in the stomach no single remedy has equally good effects. Krüger, Fischer, and Hirsch report similar results when there are acid eructations, a vesicular eruption on the buccal mucous membrane, or a severe pain darting from the back to the epigastrium.¹ It has also been recommended, by Parker, Copland, and Hudson,² in cases characterized by acute pain and tenderness in the epigastrium, distension of the stomach after meals, thirst, costiveness, and vomiting of a sour liquid. When these symptoms coincide with leucorrhœa, the nitrate of silver often cures the latter disease while it is relieving the former.

Diarrhœa. Graves recommended nitrate of silver in the diarrhœa of *phthisis*, as better than opium and astringents. He directed one grain three or four times a day. But he did not advise it when the bowels were supposed to be ulcerated. It is in these very cases, on the contrary, that we believe the peculiar advantages of the medicine to be shown. We have seen the pulmonary symptoms of phthisis remain quiescent while the strength was rapidly wasted by frequent and profuse discharges from the bowels, which all means failed to moderate until nitrate of silver reduced their number to one or two in the twenty-four hours. Dr. Macgregor, of Dublin, used this remedy with striking advantage in ordinary chronic diarrhœa, as well as in that of phthisis.³ It should be associated with opium in such cases.

Hirsch found it to possess almost specific powers in *diarrhœa ablactatorum*, when given in solution by the mouth and also by the rectum. It has been very highly recommended in this, and in the inflammatory or *dysenteric* forms of bowel complaint occurring in infancy and childhood. It may be given by the rectum, dissolved in water (gr. ss to gr. ij, dissolved in water, f̄ij to f̄iv), after cleansing the bowel by a simple enema; or by the mouth, in the same or in a proportionately smaller dose.⁴ It is very favorably estimated by Eberle,* Trousseau, and by Dr. J. F. Meigs, who remarks that when

¹ DIERBACH, i. 528; iii. 638.

² BRAITHWAITE'S Retros., 1840, p. 73.

³ Lancet, Sept. 1841, p. 937.

⁴ DUCLOS, Bull. de Thérap., xxxvi. 241, 345.

given by the mouth its influence over the disease is less immediate than when used by injection, but is more permanent.¹ By the former way a teaspoonful of the above solution should be given every two or three hours, and by the latter the quantity mentioned above may be administered two or three times a day.

In the diarrhoea of *typhoid fever* it has been recommended by Boudin, Ebers, Kalt, J. K. Mitchell, of Philadelphia, and others. The local lesion it is intended to heal, the ulceration of Peyer's glands, which may be regarded as the cause of the diarrhoea, is not, however, the primary link in the morbid chain which constitutes the disease. The intestinal ulcers may, indeed, become a source of danger by producing excessive evacuations in an advanced stage of the attack, and at that time whatever tends to heal them may conduce to the patient's safety. To give the remedy earlier, or when the discharges are few or small, would be useless, if not hurtful.

In *Asiatic cholera* this medicine was found serviceable by M. Barth in controlling the alvine evacuations as well as in arresting the obstinate vomiting of the disease.² He prescribed it in solution by the mouth and rectum, and in doses of one grain.

Dr. Peebles affirms that he has had many occasions to demonstrate the value of this medicine in "chronic idiopathic jaundice."³ The cases he had in view seem to have been those of chronic dyspepsia with epigastric pain and tenderness, and an icteric suffusion of the skin. In 1839, Retzius, of Stockholm, treated *amenorrhœa*, supposed to depend upon torpor of the uterus, by injecting a solution of lunar caustic (one or two grains to the ounce) into the cavity of the uterus immediately before the menstrual period.⁴ Kopp, of Hanau, considered this substance a powerful sedative of the abnormal action of the heart, both in functional and in organic diseases of that organ.⁵ There is some reason to believe that this medicine in a measure controls mucopurulent discharges from the lungs,⁶ and the night sweats that are apt to accompany them.⁷ Franklyn, Bruce, Pittschart,⁸ and Powell⁹ have reported numerous cases of the success of this remedy in *chorea*, but in most of them it appears to have been associated with agents of more demonstrable virtue. This was not true of Powell, however. He gave the remedy alone, and successfully, after the failure of other means.

¹ Diseases of Children, 2d ed., p. 369.

² Am. Journ. of the Med. Sci., July, 1849, p. 59.

³ DIERBACH, iii. 665.

⁴ Ibid., p. 663.

⁵ BALFOUR, N. Eng. Journ., vii. 319.

⁶ J. WARE, *ibid.*, viii. 214.

⁷ RICHTER, *op. cit.*, iv. 431.

⁸ Trans. of Lond. Coll. Phys. (1808), iv. 85.

Epilepsy. Nitrate of silver is said to have been used by Paracelsus in this disease, and Stahl and Tissot recommended it. It seems, also,¹ to have been the principal ingredient of a secret medicine much employed for epilepsy in Austria during the time of Stahl. In 1794 Sims² reported it to have been very efficacious in his hands. "One effect," he remarks, "that I perceived in some of the successful cases, was that on beginning it the first paroxysms were aggravated, although the disease afterwards yielded to its continued use." Heim, says Romberg,³ "found it the most effectual remedy for the disease that he had used during a professional life of sixty years. It was introduced by the British physicians Wilson, Harrison, and Roget. They administered it in doses of one, two, three, or even six grains, three times a day." It would scarcely be profitable to furnish a complete history of the results of the treatment of epilepsy by this medicine. As in the case of all other means used for curing the disease, it has often been successful, and much oftener failed completely. We may reasonably conclude that this result is owing to the cases of epilepsy being themselves extremely various in their nature. Existing data do not, it is believed, afford the means of distinguishing the several varieties of the affection so as to enable us to assign an appropriate set of remedies to each. The class which includes all the eccentric forms is doubtless the one in which this medicine finds its appropriate application, and the particular cases which it is best adapted to cure are probably those in which the nervous temperament and a morbid susceptibility to impressions, united with a feeble or torpid state of the organic functions, exist. But the same is true of oxide of zinc, of certain narcotics, and of tonic treatment in general. It may well be doubted whether cases that resist the persevering and methodical use of these remedies will yield to nitrate of silver.

Locally.—Croup. The earliest notice of the employment of lunar caustic in the treatment of this disease (*pseudo-membranous laryngitis*), appears to have been by Prof. Mackenzie,⁴ in 1825. Observing that the pseudo-membranous exudation very frequently commences on the surface of the tonsils and thence spreads upwards along the arches of the palate, and downwards upon the pharynx and into the larynx, he applied a solution of this salt (Ag to water 3j) by means of a camel's hair brush, once or twice a day, to the whole lining membrane of the fauces, and, when necessary, to the lower part of the pharynx. He found it

¹ COPLAND, Med. Dict., art. Epilepsy.

² Memoirs of Med. Soc. Lond., iv. 379.

³ On Nervous Diseases, Sydenham Soc. edition, ii. 228.

⁴ Edinb. Med. and Surg. Jouru., xxii. 294.

uniformly to alleviate the symptoms, and generally to cause an exfoliation of the false membrane. Gendron claims to have treated pseudo-membranous angina by the same means and in the same year.¹ In 1826, Dr. Lewis Belden, of New York, treated ten cases of pseudo-membranous angina and secondary croup with solid caustic, or a saturated solution of it applied on a swab to the parts affected.² In 1828, Bretonneau,³ and also Guimier, made use of the same method, and almost simultaneously Mr. Webster, of Dulwich, England, described the beneficial effects of the remedy in "a peculiarly fatal affection of the larynx," which appears to have been pseudo-membranous angina and secondary croup. He applied the solid caustic to the fauces and the parts bordering upon the glottis, and also to the skin of the neck covering the larynx and trachea, and sometimes used a solution of the salt of the strength of ten grains to the ounce.⁴ About this time Gérourard recommended a similar treatment, advising that the caustic should be introduced into the larynx, and Authenae published some cases in which eauterization had proved very beneficial.⁵ In 1833, J. H. Robertson used a solution of from forty to sixty grains to the ounce, as an application to the posterior fauces, tonsils, and pharynx, in what seem to have been cases of œdematous laryngitis.⁶ In 1837, Hatin published his treatment of four cases of croup (?) according to the method of M. Peronneau. He cauterized the whole posterior fauces, holding the tongue down by means of a spatula made by bending a metallic blade at an obtuse angle, and he remarks that the larynx may be entered for the purpose of destroying false membrane, even after this latter has extended to the trachea.⁷ In 1839, Bretonneau successfully treated a case of secondary croup in the adult, by means of a solution of nitrate of silver (ʒiiss to ʒj of water), which he introduced into the larynx by pressing a sponge saturated with the caustic upon the opening of this organ behind the epiglottis.⁸ In the same year Asmus employed solid caustic in the same manner, and for the same disease.⁹ In 1841, Dr. R. W. Gibbes, of South Carolina, eauterized the whole fauces with a saturated solution of the salt, in a case of croup; and by its means evidently saved his patient's life.¹⁰ In 1843, Nonat applied a solution of caustic to the glottis in a case of

¹ Journ. Complement., xxx. 269-275.

² Am. Med. Recorder, xiii. 125.

³ DIERBACH, Neuste Entdeck., i. 534.

⁴ HIGGINBOTTOM, Essay on the Use of Nitrate of Silver. Appendix.

⁵ Med.-Chir. Review, xiii. 459.

⁶ Ibid., xxiv. 155.

⁷ Revue Médicale, lxviii. 31.

⁸ Gaz. Méd. de Paris, Juin 23, 1839.

⁹ DIERBACH, op. cit., iii. 661.

¹⁰ Am. Journ. of Med. Sci., April, 1842.

membranous eroup, which recovered. In 1847, Latour reported a successful case in which the solution was expressed into the larynx from a ball of lint between the blades of a pair of forceps.¹ In 1847, also, Dr. Ware, of Boston, was induced, by the reported success of the method in New York, to make trial of it, which he did with gratifying success.² Various other cases were reported about the same time, which prove on examination to have been examples of stridulous laryngitis, but which were, owing to the imperfect knowledge of the gentlemen in charge of them, subjected to the harsh and very unnecessary treatment by cauterization of the larynx. Five cases, however, in which the method was used by Dr. Clark, of Boston, were not of this description. Three of them recovered, and one of these was a very serious case. It evidently was cured by the cauterization. The same remark applies to two later cases treated by the same physician.³

In 1848, Dr. Horace Green, of New York, published a small work on the pathology and treatment of eroup, in which, although no evidence is furnished of the author's acquaintance with any of the numerous precedents that have here been cited for the use of lunar caustic in the disease, he sets forth the advantages not only of its application to the pharynx and glottis in substance, and to the larynx by means of instillations, but he also advocates the direct cauterization of the whole interior of the larynx and trachea. For this purpose he recommends the use of the same instrument which Bretonneau and Trousseau had long before employed, a curved whalebone rod armed with a sponge holding a strong solution of nitrate of silver. This he advises to be carried into the larynx, and as much further downwards as the disease is conjectured to extend.⁴ He also describes a spatula essentially the same as that used by Hatin.

The illustrations which have now been presented demonstrate conclusively that cauterization of the parts on which a croupal membrane is forming, will often of itself suffice to arrest the progress of the disease, which, if allowed to run its course, will be in almost every instance fatal. Thus, when the pseudo-membranous deposit commences upon the tonsils or pharynx, the desired result may be obtained by thoroughly cauterizing the parts on which it is situated; and when the membrane has invaded the larynx, or has originally commenced in that organ, the instillation of a strong solution of lunar caustic through the rima glottidis materially increases the chances of arresting

¹ Month. Journ. of Med. Sci., Oct. 1847.

² Boston Med. and Surg. Journ., Dec. 22, 1847.

³ Ibid., Jan. 1859, p. 449.

⁴ Observations on the Pathology of Croup, with Remarks on its Treatment by Topical Applications.

the subsequent progress of the exudation. But no evidence exists to render it probable, and still less to prove, that the introduction of a sponge into the trachea (if possible) has been serviceable in any case. In the absence of direct proof of the necessity of attempting so extreme a measure, reason points to the imminent danger of crowding into a firm plug whatever tubular membranes may line the trachea at its upper part, and exposing the patient to the danger of suffocation.

The general statements which are apt to be made by enthusiastic advocates of this method are more positive and more favorable to its success than are warranted by the facts which have been published in detail. In the work of Dr. Horace Green, above referred to, and in a later publication by the same author,¹ as well as in the papers of Dr. E. N. Chapman,² the evidence that the disease treated was really membranous croup is unfortunately wanting in nearly all of the cases. To those who will remember that the only positive sign of this disease, and the only one, in particular, that distinguishes it from simple acute laryngitis, is the rejection of false membrane, which, again, should not be confounded with mucus coagulated by a solution of lunar caustic, many of the cases here referred to must appear embarrassing if not illusory. Unquestionably they are not all of the same nature, and cannot with equal propriety be adduced to sanction the treatment they are intended to illustrate.

Chronic Affections of the Larynx. Cauterization of the larynx has been more or less employed for many years, and especially to relieve chronic inflammations of this organ. It seems to have been first practised by Sir Charles Bell, in 1816, in a case of ulcerative laryngitis which bore the marks of a syphilitic nature. The patient was threatened with suffocation, and was unable to swallow liquids, on account of their passing into the larynx. A small pad of lint was fastened to the end of a catheter wire, which was bent so as to pass readily over the root of the tongue and the epiglottis. The fingers of the left hand of the operator being used to hold down the tongue and guide the instrument, its pad was saturated with a solution of lunar caustic (℞ij to ʒj of water), and introduced *into the opening* of the glottis, and pressed with the forefinger. The effect of this application was immediate relief. It was repeated several times along with other treatment, and the patient recovered.³ In 1828, a writer in an English periodical mentions having recently seen some cases where *chronic coughs*, accompanied by muco-purulent expectoration, that had harassed the patients

¹ Am. Med. Monthly, and The Charleston Journ., ix. 550.

² N. Y. Journ. of Med., xii. 213, and xiii. 68.

³ British and For. Med. Review, Oct. 1847, p. 498.

for years, and baffled all their physieians, gave way in a very rapid manner to a few applications of a solution of lunar eaustic on the sponge of a common probang.¹ In 1832, Bennati reeommended eauterization of the uvula and fauces with lunar caustic, to improve the voiee when it is weakened and has its musical seale deranged by swelling or relaxation of these parts. In the same year Trousseau, for the first time, employed a saturated solution of nitrate of silver sueeessfully for the relief of *aphonia*.² He then made use of the species of probang, which Bretonneau had eontrived, and which has since been universally adopted for cauterization of the larynx. A few years later (1836) this physieian, in eonjunction with M. Belloe, published his eelebrated essay on Laryngeal Phthisis,³ a translation of which appeared in this country in 1839. He made use of the instrument just alluded to, for applying to the interior of the larynx a solution of caustie (3j or 3ij to 3j of water), but gave the preferenee to a long syringe with a eurved tube, from which the solution, mixed with air, was thrown into the glottis. His Memoir contains seven eases of *subacute* and *chronic laryngitis*, which were entirely cured by this method, and several others of *tuberculous* and of *cancerous* disease of the same organ, the symptoms of which it palliated. In Dr. Watson's Leetures, which were published in this eountry in 1844, and very extensively eirculated, the method of direet eauterization in chronic affections of the larynx is fully deseribed. The use of the plan by Sir Charles Bell is stated, together with the fact that Dr. Arnott had twice or thrice "swabbed" the upper part of the larynx at the request of Dr. Watson, and also that the praetice had been much followed by Dr. Vane, a naval surgeon. In 1846, Chomel deseribed the symptoms of elergyman's sore-throat under the name of "granular affection of the pharynx," and stated that the only means to be relied on for its cure are causties, either in the liquid or the solid form, but of the two he preferred the former.⁴ More recently the method acquired a temporary popularity from there having been deeceptively attributed to it a power of euring or preventing *tuberculous consumption* of the lungs by its aetion on tubereulous ulcers of the larynx and trachea, and also from the singular dexterity aequired by the suggester of this idea, in "swabbing" (to use Dr. Watson's term) the air-passages.⁵ Dr. Horace Green, the physician alluded to, informs us that he has passed the probang "at will, in many instances, into the right or left bronehus, with as mueh ease and safety as the catheter is introduced into the

¹ Med.-Chir. Rev., xiii. 459.

² Bull. de Thér., i. 163, 276.

³ Mém. de l'Acad. de Méd., tom. vi.

⁴ Abeille Médicale, iii. 184.

⁵ A Treatise on Diseases of the Air-Passages, &c., by HORACE GREEN, A. M., M. D.

bladder."¹ He has also published an account of his successful introduction of tubes into the larynx, trachea, and bronchi, through which solutions of nitrate of silver and other medicinal substances were injected.

These extraordinary statements having led the New York Academy of Medicine to appoint a committee to investigate them, Drs. Parker, Wood, Metcalfe, and Stone, presented a report to that body, setting forth that numerous experiments were conducted in their presence by Dr. Green and others, from which it appeared that it was possible to introduce a No. 10 catheter into the trachea, without serious discomfort to the patient, eleven times out of nineteen, when the instrument has the curve of a circle of six inches in diameter; that a similar tube "slightly bent at its extremity" failed to enter the larynx, thirty-four times out of thirty-seven; and that the sponge probang failed to pass beyond the vocal cords in every one of eighteen trials.² These experiments ought, we apprehend, to set at rest the dispute as to the utility of an operation the very possibility of performing which is so strongly controverted, if not absolutely disproved. In regard to catheterizing the air-passages, to which the same objection does not apply, it must, however, be stated that no proofs have been adduced to demonstrate its superiority over the ordinary administration of remedies by the stomach and by inhalation, while the value claimed for it in the treatment of tuberculous phthisis is not less preposterous in theory than it is delusive in practice.

The utility of cauterizing the larynx after the manner of Sir Charles Bell, and Trousseau and Belloc, is very great in nearly all of the chronic diseases of this organ. In nervous *aphonia* its use is not without its advantage, and when this disorder arises from hygrometric conditions of the atmosphere, or from *subacute* or *chronic inflammation*, it is often curative.³ The same may be said of it in relation to chronic inflammation of the mucous *follicles* of the *pharynx* and *larynx*, known as "clergyman's sore-throat," the *dysphonia clericorum* of Dr. Mackness, although in this affection hygienic means, and other medical remedies than this one, must be combined to remedy the asthenic condition of the system of which this troublesome affection is often a symptom.⁴ Even in more deeply-rooted and constitutional maladies, which find a local expression in the larynx or trachea, such as *syphilis*, *tuberculosis*, and perhaps in some degree, also, *cancer*, although this method can effect

¹ Lancet (Am. ed.), Nov. 1852, p. 346.

² N. Y. Journ. of Med., N. S., xv. 144.

³ Trans. Med. Soc. Lond. (N. S.), i. 25.

⁴ See a Paper, by Dr. J. Scott, Month. Journ. of Med. Sci., July, 1850, p. 15; also Prof. BENNETT, *ibid.*, Nov. 1851, p. 462.

no cure, it may palliate the symptoms by rendering the ulcers of the larynx, &c., less sensitive, and may even promote whatever tendency they have to heal.

Mode of Cauterizing the Larynx. The principal instrument consists, according to the description of M. Trousseau, of a whalebone rod, a line or a line and a half in diameter at its smaller extremity, which, after having been heated in boiling oil, is bent at a curve corresponding to an angle of eighty degrees, and then allowed to harden by being placed in cold water. The smaller end, having been cut to an edge, notched, and dipped into melted sealing-wax until well coated, is surrounded with a piece of fine and dense sponge, which, if it also has been warmed, adheres to the instrument very firmly. On being wet with water, the sponge expands, when it should be trimmed into an olive shape of about three-quarters of an inch long by half an inch in diameter. A somewhat smaller size is necessary for children. In order to employ it, the sponge having been saturated with the solution, yet so that none shall drip from it, the instrument is held like a pencil in the right hand, and, the patient breathing fully and naturally, it is carried rapidly into the pharynx until the curve of the whalebone reaches the posterior wall of the pharynx. This contact excites an act of deglutition, during which the handle of the instrument is raised and the sponge drawn forward, when it can be thrust against the opening of the larynx, and the solution it contains expressed into this organ. Instead of allowing the tongue to remain free, the operation may be facilitated, in many cases at least, by using the bent spatula proposed by Hatin, or some analogous instrument, or by the finger, by which the tongue may be pressed downwards and at the same time drawn forwards. The epiglottis itself may often be made visible. A convenient depressor is that proposed by Dr. E. Watson, the blade of which is open like a horseshoe, and affords a better view of the fauces and controls better the movements of the tongue. The operation nearly always produces a momentary sense of suffocation, with retching or vomiting, which latter symptom may continue for several hours. These difficulties are best overcome by accustoming the patient to cauterization of the pharynx before the larynx is attacked, and by a rapid and dexterous manipulation of the instrument. Sometimes, when the sponge has been forcibly thrust between the vocal cords, a violent spasmodic constriction of the larynx takes place, which prevents the instrument from being easily withdrawn. This should not be too actively resisted, lest either the diseased organ be wounded, or the sponge torn off from the whalebone.

Whooping-Cough. M. Berger attributed very beneficial effects to

nitrate of silver, given internally, as a remedy for this disease,¹ and more recently Dr. E. Watson has reported cases of the striking success obtained by him from cauterizing the pharynx and larynx. Every second day he applied a solution varying in strength from the proportion of fifteen to that of forty grains to the ounce of water, and he states that three or four such applications generally put an end to the paroxysms. Cauterization of the posterior fauces alone appeared to produce a decided amendment.²

Tonsillitis. It is well known that many stimulant gargles have been used to arrest the development of tonsillitis, but none of them can be compared in efficacy with cauterization by nitrate of silver. If thoroughly performed at any time before throbbing pain in the part announces the commencement of suppuration, the affection will seldom advance any further. The method is especially to be recommended for those persons who are subject to quinsy, for if duly applied during two, or at most three, days in succession, suppuration will very rarely take place.

The value of local counter-irritation in *neuralgia* is well exhibited by the effects of nitrate of silver, which Higginbottom applied so as to *blister* the skin along the course of the affected nerve. It would be sufficient to apply it over those points of the nerve which are most superficial, and where pressure with the end of the finger excites pain. As requiring less trouble and attention, it may form a convenient substitute for cantharides in these cases (vid. *Cantharides*). This caustic has also been applied over the course of *lymphatic vessels* inflamed by ulcers and wounds, as well as in idiopathic inflammation of these organs, so as to vesicate the skin. Behrens recommended it in *paronychia*, employed so as to produce a blister over the seat of pain. If the inflammation is in its first stage, it is generally cut short; and if the treatment does not succeed, the case is no worse than before, and an incision must be made. It is recommended to make a large opening, and cauterize the interior of the abscess.³ Other forms of phlegmonous inflammation may be treated in the same manner.

Ophthalmia. This caustic has long been employed in *chronic* inflammations of the eyes. Scarpa especially advocated its use for ulcers of the cornea and of the eyelids. It does not produce any inflammation of the surrounding parts, but rather allays the inflammation which already exists there. As Mackenzie remarks, it is much superior to any

¹ *Annuaire de Thérap.*, 1846.

² *Month. Journ. of Med. Sci.*, Dec. 1849, p. 1287. See, also, JOUBERT, *Bull. de Thérap.*, xlii. 41.

³ DIERBACH, *op. cit.*, iii. 681. GUNIER, *Bull. de Thérap.*, liii. 314.

anodyne or sedative lotion, and even to any narcotic taken internally. When the ulcers are deep, the solid caustic is most efficient; when more superficial, a solution of from four to ten grains in an ounce of distilled water may be applied by means of a camel's hair pencil. But neither method should be used, except with extreme delicacy, when the ulcers show a tendency to heal. If *hernia* of the lining membrane of the anterior chamber, or of the iris, should occur, the projecting portion may be excised, and the opening touched with a caustic pencil. This remedy may also be employed to remove granulations of the conjunctiva, but it is less efficient than sulphate of copper.

It is in *acute* inflammations of the eye that the virtues of lunar caustic are most conspicuous, but especially in those of the *conjunctiva*. On this point Velpeau expresses himself as follows:¹ "Inflammations of the ocular conjunctiva, whether simple, granular, partial, general, or purulent, most frequently yield with astonishing rapidity to the use of this remedy. I have seen conjunctivitis with complete chemosis, whether treated at the second or third, or at the eighth or tenth, day, stop short and disappear under its influence in a week's time. Purulent conjunctivitis, of the highest grade, has been dissipated by it innumerable times." "It is now well known that genuine purulent ophthalmia, whether that which attacks new-born children, the Egyptian, the epidemic, or the gonorrhœal varieties, resists all derivative and antiphlogistic treatment. The last-mentioned of these yields more promptly to a strong solution of nitrate of silver than to any other collyrium whatever. While yet the inflammation is moderate, a solution of seven or eight grains to the ounce generally suffices. When the secretion becomes distinctly purulent, and there is considerable chemosis, a solution of from fifteen to thirty grains to the ounce is not too strong; and when the conjunctiva is puffy and grayish, the eyelids red and tumid, a solution of from forty to sixty grains should be at once employed. With these solutions, however violent the attack may be, there is great hope of success so long as the cornea remains transparent. But, to attain this end, the solution must be thoroughly applied to the inflamed membrane two or three times a day, after first washing away the accumulated pus. With these precautions the advance of the inflammation may be abruptly terminated, and after the first day the solution may be less frequently applied, and on the following days its strength may be diminished, but gradually, and in proportion to the decline of the attack." The method of treatment in ophthalmia neonatorum is essentially the same. For *blepha-*

¹ Bull. de l'Acad. de Méd., ix. 39.

iritis the best form of application is an ointment, which must vary in strength from one to three or four grains to a drachm of pure lard, and which ought only to be applied after the parts have been cleansed of the concretions which cover them. When, however the disease is chronic, and the conjunctiva has become thickened, the solid caustic is preferable. In all cases in which a solution of caustic is to be applied to the whole surface of the conjunctiva, it should be introduced between the lids at the external canthus by means of a dropping tube or a small glass syringe. In the employment of this solution care should be taken not to persist in its use for too long a period, lest a discoloration of the conjunctiva should result, giving to this membrane a dirty greenish-brown stain, and producing a permanent and very obvious deformity. Cicatrices of the cornea are occasionally stained black by it.¹ An ointment of nitrate of silver, and also solutions of this substance, have sometimes been used successfully in the treatment of *ozæna*. Gallizioli reports four cases to have been cured by the use of an ointment containing eight grains of the salt to an ounce of lard.²

Higginbottom proposed to use nitrate of silver as a *vesicant*, in order to prevent the danger of strangury and constitutional irritation produced by cantharides, as well as because it acts promptly. It induces a very copious discharge, without heat or pain after the first few hours. The vesicated part heals about the fifth day, without leaving either ulcer or scar. Dr. G. McClellan, of Philadelphia, was in the habit of using it to blister the brow in certain affections of the eye, and particularly *iritis*, in which we have seen its good effects. Delvaux relates several cases³ in which local vesication promptly put an end to *pains in the chest*, which appear to have been neuralgic or rheumatic in their nature. This caustic often succeeds in arresting the bleeding from *leech-bites*. If the skin is the seat of the puncture, it should be raised in a fold and held for a moment during and after the use of the caustery, so as to permit the full action of the latter on the wound. A pointed probe, covered with powdered caustic, and heated near the flame of a candle till fusion occurs, presents the best instrument for this little operation.⁴ Higginbottom suggests that in cases of *punctured and lacerated wounds* the caustic should be applied within and around their orifice as far as any swelling extends. He states that it prevents the tenderness and pain of suppuration. But if this process have already commenced, he advises that the wound itself, as well as the adjacent parts, should be thoroughly cauterized. This treatment is

¹ MACKENZIE, op. cit., p. 238.

² Bull. de Thérap., li. 277.

³ Month. Retrospect, June, 1849, p. 130.

⁴ DIERBACH, op. cit., iii. 678.

recommended in wounds made by nails, hooks, bayonets, saws, venomous insects or reptiles, dissecting instruments, spiculæ of bone, &c.

Ulcers. Small *ulcers*, and such as are free from active inflammation and discharge but little, and, also, are not exposed to much motion or friction, may often be healed by forming an artificial cuticle upon their open surface by means of lunar caustic. After cauterizing the sore and its edges, dry lint should be applied and sustained by a roller, nor should the dressing be disturbed before the third or fourth day. The application of the caustic may then be renewed.¹ In other cases and when the sore is small, the caustic should be applied upon the surrounding skin also. No dressing is necessary. If matter forms underneath the eschar, it can be evacuated by a small puncture, which can then be closed by a touch with the caustic. In *indolent* ulcers, after reducing the irritation by rest and sedative applications, the part should be well cleansed and dried and then cauterized, after which lint should be applied and covered with linen spread with a mild ointment, and the whole supported by a compress and roller. The same process may be repeated every fourth day until cicatrization is complete. In general, the combination of this method with that by adhesive straps is the most effectual in the class of ulcers referred to.²

The practice of destroying *chancres* by lunar caustic seems to have originated with John Hunter. As he remarks, the operation, to be effectual, must be performed on the first appearance of the sore, while the surrounding parts are still uncontaminated, for it is essential that the whole diseased part should be removed. Ricord has fully confirmed the soundness of Hunter's doctrine. According to him, when a chancre is destroyed by caustic before the sixth day after infection, or, according to Acton, within three days after the appearance of the vesicle, the cure is very rapid, and contamination of the system rarely follows. When once the chancre has become indurated, cauterization neither prevents nor favors constitutional infection. It can no longer be considered an ectrotic treatment. It has sometimes been objected to this method that it causes many innocuous pimples to be destroyed under a suspicion of their syphilitic character. But it has been well answered to this objection³ "that it is far preferable to cauterize nine simple sores than allow one specific ulcer to gain ground." To apply the caustic, Hunter recommended that it should be pointed like a pencil so that it may touch those parts only which are diseased. If a vesicle or pustule is to be destroyed, its contents should first be

¹ HIGGINBOTTOM, op. cit., p. 112.

² Ibid.

³ ACTON, Lectures. Lancet, April, 1846, 457.

evacuated by incision and pressure and the point of the caustic pressed into its cavity. The cauterization of syphilitic ulcers should be repeated as often as the eschar formed upon them is thrown off, and until the edges show a tendency to cicatrize, when these latter should be spared, while the centre of the sore is still lightly touched. No other dressing than a little lint is needed.

Bretonneau, Velpeau, and also Serres made some experiments upon the eruption of *smallpox* by removing the summits of the pustules and cauterizing their interior. When this was done within the first three days of the eruption, the pustules aborted and left no cicatrix behind them.¹ Although it has been objected to this plan that it creates pain and fever and exhausts the patient, and occupies a great deal of time,² yet there may be cases in which the prevention of scars may be cheaply purchased even by these inconveniences. In other diseases of the skin this remedy is seldom available. A weak solution of it may be used in *intertrigo infantilis*, the vesicular eruption so common behind the ears, in the groins, &c., of children, but cauterization of this, as of most other eruptions, exasperates it. In *zona*, it is true, the pain may be somewhat lessened, but perhaps at the expense of protracting the disease; *herpes circinatus* is nearly in the same case; in *eczema* it is useless or worse, and in *rupia* it has no appropriateness until ulcers form and the cutaneous eruption proper is extinct. It has been recommended for *frost-bite*, but it is neither as safe nor as efficient as turpentine, &c.

For *sore nipples* Hannay used a finely-pointed caustic pencil to touch the raw surfaces of the fissures, after which he washed them with warm milk and water. The pain was severe, but brief, and dressings of the carbonate of zinc completed the cure. In many cases the application must be several times repeated.³ A weak solution of the salt has also been successfully used for the same purpose (4 to 6 grains to 3j of water). A piece of lint wet with the solution is applied to the nipple after the infant has nursed, and the part must be washed before the child takes the breast again.

The caustic treatment was very successfully applied by Higginbottom to the cure of superficial *burns and scalds*. Fricke employed it in burns involving the true skin, to prevent the formation of disfiguring cicatrices. He cauterized the whole burned surface after evacuating the vesicles and removing the epithelium, and on the following days renewed the application wherever new vesicles or moisture could

¹ Archives Gén., viii. 433. More recently see Times and Gaz., Dec. 1856, p. 591.

² WILSON, Dis. of the Skin, p. 64.

³ DIERBACH, op. cit., i. 536.

be seen. In this manner a protecting scab was formed which, like cotton under similar circumstances, acted by excluding the air.¹ Indeed J. E. Cox recommended the application of carded cotton after the use of the caustic.² The more superficial the burn is, provided the true skin is at all interested, the better does this treatment succeed.

Erysipelas. Nitrate of silver has been very extensively used to allay the inflammation and arrest its progress in this disease. Some, like Liston and Elliottson, preferred to cauterize the sound skin beyond the limits of the erysipelas, while Higginbottom, with whom it is believed the practice originated (1828), made use of cauterization upon the inflamed surface and beyond it. He did not, at the same time, neglect depletion and purgation. The pain produced by this application is sometimes very severe, but it does not last long and is followed not only by great relief to the local symptoms, but by a marked abatement of the constitutional disturbance also. In a more recent essay on the use of nitrate of silver in erysipelas,³ this author reiterates his earlier statements of its value, and advocates an extension of its use to cases in which the scalp is affected even with the idiopathic form of the disease. For this purpose the solution proposed by Mr. Gooch (argent. nitrat. ℥iv., acid. nitric. gtt. vj., aquæ destill. ℥iv.) is the best form of the caustic. The affected part must first be shaved, or the hair cropped very closely. The scalp should then be freed of its greasiness by means of soap and water, and afterwards washed with pure water to remove any particle of soap remaining. The concentrated solution may then be applied several times as well on the inflamed part as to the extent of two or three inches beyond its margin. In the course of twelve hours it will be seen whether any parts of the skin have remained untouched, or whether the inflammation has extended. In either case the solution must be applied again. Many authors might be cited who attest the value of this method, such as Tanchou,⁴ Martin Solon,⁵ Jobert,⁶ &c., but the foregoing statements are perhaps sufficient.

Dr. F. Hunt used the solid caustic to arrest *salivation* and cure the ulcerated gums resulting from this process. It is, however, a far inferior application to muriatic acid. A solution of this salt forms a useful wash in chronic *otorrhœa*.

Gonorrhœa. Attempts have been made to cut short this disease by means of a strong injection of nitrate of silver. The method is said

¹ DIERBACH, op. cit., i. 536.

² Ibid.

³ RANKING'S Abstract, 1847, i. 23.
Bull. de Thérap., vii. 253.

⁴ Lancette Française, 1831, v. 120.

⁶ Annales de Thérap., Juill. 1843.

to have originated with Carmichael. It was practised by Wallae,¹ who employed a solution containing fifteen grains to the ounce, and subsequently by Rieord.² The last physician was careful to point out that unless the remedy were used before the acute inflammatory stage, very serious mischief might ensue. Although the method, in his hands, sometimes produced wonderfully rapid cures, yet the extreme pain of the application and the severe inflammation it sometimes excited, led him afterwards almost entirely to renounce its use. After the subsidence of the acute stage, however, when astringent injections in general become appropriate, none is more efficacious than a weak solution of this salt (gr. ij to $\bar{\text{iv}}$), made use of every three or four hours. Gonorrhœa of the glans penis (*balanitis*) is very advantageously treated by eauterizing the part superficially, and interposing dry lint between the glans and its covering. The lint should be renewed as often as it becomes saturated with pus. If the prepuce cannot be retracted, a stronger solution than the one mentioned (gr. xx-xxx to $\bar{\text{ij}}$) may be injected through its opening.

Gonorrhœa in *females* is readily cured during its early stages by direct eauterization. The solid caustic may be applied, according to circumstances, to the vulva alone, or to the vagina. In the latter case, a glass speculum should be made use of, through which the mucous membrane may be eauterized in its whole extent, after which lint should be introduced. After the first application of the solid caustic, and also in mild cases, a strong solution of the salt should be used every second or third day.

Leucorrhœa. A large number of writers upon this disease speak favorably of its treatment by nitrate of silver. Hannay (1840) used solid caustic, introducing it as far as the os uteri, and while gradually withdrawing it eauterized the whole mucous membrane of the vagina by giving a rotary motion to the caustic-holder. He states that out of 300 cases, 280 were cured by a single application of the remedy. Other reporters are far from confirming these results. Some declare that the method cures but a small proportion of the numbers treated, others state that the cure is not permanent and radical, and others still that it produces no good effects whatever. These discordant results must unquestionably be referred to the circumstance that unsuccessful cases were principally those of uterine leucorrhœa, while those in which the treatment was curative were probably examples of a muco-puru-

¹ A Treatise on the Venereal Disease (Dublin, 1833), p. 254.

² See also JOHNSON and BARTLETT (1817), Edinb. Med. and Surg. Journ., xiv. 263; ARNOTT, McDONALD, DEBENY, &c., RANKING'S Abstract, v. 221; BURNETT, Lancet, May, 1833.

lent discharge from the vagina, nymphæ, &c. In the first variety, an exclusively local treatment is seldom curative, unless the disease is confined to the neck of the womb. Vidal, it is true, cured some cases by the direct introduction of a caustic solution into the uterus, but these are exceptional instances, and the method itself, being a dangerous one, is not to be recommended. In vaginal leucorrhœa, on the other hand, when the disease has passed the inflammatory stage, or is originally subacute in its form, no local application is so effectual as the one in question. The strength of the solution should vary with the grade of the inflammation; the more chronic forms requiring the strongest solution.

Chronic inflammation of the *bladder* has been successfully treated by means of caustic injections¹ of the strength of two grains to the ounce. Mr. Reeves² reports several cases in which the extreme suffering and annoyance of the affection were entirely removed by injections of twenty grains of the nitrate of silver to an ounce of water.

Nitrate of silver was employed by J. Hunter for the cure of *strictures of the urethra*, through which a bougie could not be passed owing to the density of the obstacle or its position in the canal. He at first made use of a canula containing a wire, to the end of which a piece of caustic was firmly attached, and afterwards of a bougie with caustic let into its extremity. This he applied every day or every other day for a minute at a time, provided the inflammation produced did not forbid so frequent a repetition of the process. This method is applicable to spasmodic strictures and those of moderate extent. When the stricture is long and hard, cauterization is comparatively of little service, except to reduce the morbid sensibility of the part, and hence to render attempts at dilatation more successful. If, however, the stricture can be entered by the cauterizing instrument, the action of this latter will facilitate the passage of bougies. An instrument, invented by Ducamp and improved by Lallemand, may be employed to cauterize the sides of the stricture when this latter can be entered. It is also very convenient for making local applications of caustic to any part of the urethra, and to the neck of the uterus. It has been very extensively employed in cases of *involuntary emissions* of semen to cauterize the prostatic portion of the urethra.

Lunar caustic is a useful agent for removing *corns*. The hardened and thickened cuticle should first be softened by warm water or a poultice, and then pared away carefully so as to avoid drawing blood. The corn should then, after being moistened, be thoroughly rubbed

¹ Am. Journ. of Med. Sci., Oct. 1847, p. 481.

² Lancet, June, 1853, p. 536.

with the caustic. In about a fortnight, or whenever the blackened eschar is about to separate, the same process should be repeated, and afterwards renewed if necessary.

ADMINISTRATION.—Nitrate of silver may be given internally in substance or in solution, but the former mode is almost universally preferred. It is generally prescribed in the pilular form made up with crumb of bread, as it was originally by Boyle, in 1672. But as this substance contains salt, which decomposes the nitrate, in part at least, the latter may be triturated with some vegetable extract (Sementini), or some mild vegetable powder with mucilage. The dose is at first about one-quarter of a grain three times a day, but may be gradually increased to five, ten, or more grains in the same space of time. If given in solution, the dose ought not to exceed one-third of that mentioned. No food containing salt ought to be taken immediately before or after its ingestion. A convenient mode of preserving fused lunar caustic is to dip it into melted sealing-wax, by which means it gets a coating which protects it from the air. It may then be cut to a point like an ordinary pencil.

ANTIDOTE.—Chloride of sodium (common salt), largely diluted and in sufficient quantity to produce emesis. The excessive local action of this substance on the skin, fauces, vagina, &c., may be checked by the same agent.

CUPRI SULPHAS.—SULPHATE OF COPPER.

SOURCES.—Native crystals of sulphate of copper, as well as a solution of this salt, are found in the waters of copper mines. It is also obtained by roasting the native sulphuret of copper, and sometimes by the direct action of sulphuric acid upon the metal.

PROPERTIES.—It is generally met with in large crystals of a beautiful dark blue color, which have a styptic, metallic, and very disagreeable taste, and a brassy smell when rubbed. It is soluble in one-third of its weight of cold water, and effloresces when exposed to the air. Of its *incompatibles* the following may be mentioned as most important: the alkalies, earths, soluble subcarbonates, salts of lead, acetate of iron, and astringent vegetable infusions and tinctures.

ACTION. *On Animals*.—Schubarth found that half a drachm of this salt given to a dog produced violent vomiting and straining, followed by exhaustion, but the animal was well in twenty-four hours.¹ Much smaller doses have proved fatal to dogs. In an experiment of Drouard

¹ WIEBNER, *Wirkung*, &c., ii. 260.

twelve grains caused the animal's death. Large doses, indeed, are fatal in a very short time, if vomiting is prevented by ligation of the œsophagus. Besides vomiting, and attempts to vomit, the other symptoms noted are convulsions, great insensibility, and paralysis. After death the only lesion discovered is more or less inflammation of the stomach. When the other viscera are subjected to the action of hot water and nitric acid, appropriate tests reveal the presence of copper.¹

On Man.—Applied to mucous membranes generally, or when taken internally in small doses, as a quarter of a grain, several times a day, its action may be regarded as astringent and tonic. Applied to a wound or ulcer, it coagulates the albumen by combining with it, in the manner of an astringent, but it has no destructive or caustic action. Its action upon the stomach, in large doses (5 to 15 grs.), has much in common with that of sulphate of zinc, common salt, alum, mustard, &c.; in other words, it is an irritant emetic. Like theirs, its action is extremely prompt and rapid, and it leaves no nausea nor malaise behind it. Clarus regards it as acting less upon the mucous coat of the stomach than upon the pneumogastric nerve.² Large or poisonous doses (3ss or more) are by no means always fatal. In a case in which five drachms were taken the symptoms were indeed severe, but under the influence of diffusible stimulants the patient recovered.³ Another case is recorded in which *an ounce* was swallowed, with suicidal intent, after a glass of rum punch. The patient refused to take an emetic, but nevertheless recovered.⁴

The symptoms of acute poisoning by this substance are, according to the dose, and the powers of the constitution, headache, insensibility, convulsions, tetanus, contracted features, small pulse, cold skin, colic, vomiting, which is generally violent, and sometimes suppression of urine, and occasionally jaundice. Recovery is usually rapid and complete. Sometimes, but rarely, there remains for several weeks a liability to vomiting, with colic and diarrhœa, extreme debility and more or less emaciation. There is a form of enteritis marked by diarrhœa, tenderness of abdomen, vomiting, and sometimes bloody stools, which is produced by exposure to the emanations of copper and by the ingestion of its salts (the acetate especially) mixed with the ordinary food; but such effects are not traceable to the sulphate, of which several grains a day have been taken for a period of one or two months, or even much longer, without any constitutional disturbance.⁵

When death occurs soon after a poisonous dose of this substance

¹ DANGER and FLANDRIN, *Annales de Thérap.*, i. 254.

² *Arzneimittellehre*, p. 880.

³ TAYLOR, *Med. Jurisp.* (Am. ed.), p. 370.

⁴ DIERBACH, *Neuste Entdeck.*, iii. 698.

⁵ BLANDET, *Journal de Méd.*, 1845, p. 68.

has been swallowed, the only perceptible lesion is an intense redness of a portion of the gastric mucous membrane, and more or less inflammation of the œsophagus and small intestine. When the dose has been very large and fatal, after a considerable interval ulceration and sloughing of the bowels have been found, and even perforation of the peritoneum.

USES. *As an Emetic.*—"It has been recommended for its rapid operation as an emetic, but sulphate of zinc is quite as prompt in its action, without involving a risk of permanent injury to the stomach." This statement of Richter,¹ which also has been repeated by Christison, has no foundation in fact. We can discover no case in which emetic doses of sulphate of copper have proved in any degree mischievous, and do not hesitate to recommend it as the equivalent of sulphate of zinc in cases of *narcotic poisoning*, or whenever vomiting without nausea is to be excited.

Croup. It was first used in Germany as an emetic in this disease by Hoffmann, of Hesse, in 1821. Kopp, who soon afterwards published a statement of its efficacy,² was followed by a host of writers equally loud in its praise, and of whom may be mentioned Zimmermann, Fielitz, Gittermann, Serlo, Malin, Droste, Wunderlich, Hankel, Nyborg Camerer, Schlesier, Schwabe,³ and Aberle.⁴ A very large proportion, how large cannot certainly be known, of these cases, were of spasmodic croup, and prove conclusively, it may be incidentally remarked, that nauseants are not essential to produce the resolution of that disease. But all of the cases were not of this description. Not a few were examples of pseudo-membranous laryngitis. But leaving those just referred to out of the question, reference may be made to the report of Béringuier,⁵ containing five cases, in all of which the pseudo-membranous form of the disease was unequivocal. They all recovered under the use of this substance administered after depletion, which latter agency, indeed, the reporter considered as a very important preparation for the emetic. M. Béringuier gave two grains of the medicine, and repeated this dose in five minutes, unless vomiting occurred sooner. Sometimes he increased the dose to four grains. In no instance were any bad consequences produced by it, and particularly no irritability of the stomach. Godefroy⁶ also reports seventeen cases of "croup," ten of which were unquestionably of the pseudo-membranous form. These all recovered under the use of the emetic, together with deple-

¹ Ausfürlich. Arzneim., iv. 493.

² Brit. and For. Med. Rev., i. 568.

³ DIERBACH, op. cit., iii. 699.

⁴ Brit. and For. Med. Rev., xvii. 557.

⁵ Annales de Thérap., iv. 151.

⁶ Bull. de Thérap., xxix. 72, and Journ. des Connaissances, &c., Juill. 1845.

tion and cauterization of the pharynx. Marel also reports¹ eight cases of pseudo-membranous croup, six of which recovered after the use of emetic doses of sulphate of copper, and Missoux alleges that he lost but two out of twenty-two cases in which the medicine was administered in five grain doses.² Kissel saved twelve out of fourteen cases of this disease, by using an alcoholic solution of the acetate of copper. He maintains that the medicine cures less by its emetic operation than by a specific action in non-emetic doses.³ It is due to a just appreciation of this subject to state that the testimony which has been adduced is not wholly uncontradicted. Dr. Hannay⁴ states that he made a fair and careful trial of it in six cases, and in all the issue was death. Such of the particulars as are furnished corroborate his general statement, and show that he not only used the remedy faithfully, but conjoined with it, also, depletion and mercurial inunctions. On the whole, it follows from the above survey of the subject, that sulphate of copper is a valuable emetic in croup whenever emetics can do good, but that it will fail whenever the act of vomiting, vigorously performed, is unable to free the air-passages of the concretions that line them.

Diarrhœa.—Elliotson⁵ regarded it as superior to every other astringent in chronic diarrhœa. He administered it in pilular form, combined with opium, in doses of from one to three grains three times a day, and given after meals. If taken alone, and upon an empty stomach, he found that it sometimes occasioned nausea and diarrhœa. Pereira employed it successfully for infantile diarrhœa, in doses of one-twelfth of a grain.

Intermittent Fevers.—It is stated, by Hoffman, Adair, Richter, and Monro, to have been very effectual in obstinate quartan and other agues. Of its use in quartans, Chapman says:⁶ "I know not a remedy entitled to much greater confidence." He gave it in doses of one-quarter of a grain, combined with opium, three or four times a day. It has also been given in *atonic dropsy* and in several *convulsive diseases*, but its value in these cases is far from being ascertained.

Externally.—The most ordinary application of sulphate of copper is to repress the exuberant or flabby granulations of certain *ulcers*, and to stimulate such as are slow to granulate. It is much used for syphilitic ulcers of this character, and also for phagedenic ulcerations. In chronic forms of *conjunctivitis*, particularly with a granular state of the membrane, the application of a crystal of sulphate of copper to the ocular surface of either eyelid is often of great service. In solution it

¹ Bull. de Thérap., xxxviii. 327.

² Bull. de Thérap., lv. 555.

³ Journal für Pharmacodynamik, i. 194, 198. ⁴ Lond. Med. Gaz., July, 1840, p. 583.

⁵ Med.-Chir. Trans., xiii. 451.

⁶ Therapeutics, ii. 451.

has also been used to arrest the development of purulent ophthalmia. Dr. B. H. Coates¹ found this remedy, "beyond all comparison," the best for "*gangrene of the mouth*." The epidemic which Dr. C. describes was one of *ulcerative stomatitis*; but the value of the application in gangrene of the mouth, also, is attested by Dewees, Drs. Condie, J. F. Meigs, and others. Dr. Coates used the following formula: R.—Cupri sulph. ʒij; pulv. cinchonæ ʒss; aquæ ʒiv. S.—To be applied to the ulcerated parts twice a day. Sulphate of copper may also be used for *superficial ulcers* of the mouth; to arrest the flow from *bleeding surfaces*, such as ulcers or wounds in spongy tissues; as a wash in *gutta rosacea* (gr. ij to ʒj); dissolved in whiskey, as a wash in *alopæcia*; to correct *foul odors* arising from gangrenous parts; as an injection in *gleet* and chronic *leucorrhæa*, &c.

ADMINISTRATION AND DOSE.—This medicine is administered internally either in substance or in solution, but the former mode is preferable. As an emetic, from *two to fifteen* grains in powder, mixed with white sugar, may be given every ten minutes until vomiting takes place. As a tonic or astringent, from *a quarter* of a grain to *two or more* grains may be prescribed, in pilular form, three or four times a day. For external use solutions are chiefly employed. They may contain from *one to ten or more* grains to the ounce of water. The solution should not be measured in a silver spoon, which it discolours by the precipitation of metallic copper.

ZINCI CHLORIDUM.—CHLORIDE OF ZINC.

PREPARATION AND PROPERTIES.—This substance is prepared by dissolving zinc or its oxide or carbonate in hydrochloric acid, and then filtering the solution and evaporating it to dryness. It is a grayish-white, semitransparent, and gelatinous substance, but, if fully dried, becomes solid and pulverizable. It deliquesces on exposure to the air, is soluble in water, alcohol, and ether, and unites with both albumen and gelatin. It has an acrid and metallic taste.

ACTION.—In small and properly-adjusted doses chloride of zinc is said to act as a stimulant and tonic to the nervous system, and to increase the urinary secretion. In large doses it is a powerful irritant poison, occasioning pain in the stomach, nausea, vomiting, anxiety, quick, short breathing, a small, rapid pulse, cold sweats, syncope, and convulsions.²

¹ N. Am. Med. and Surg. Journ., ii. 20.

² WILMER, Wirkung, &c., v. 458.

Applied *externally*, it is, when undiluted, a powerful corrosive irritant, but, according to Hancke, it differs from several other caustics—those, for example, prepared with corrosive sublimate and arsenic—in producing but little pain or mischievous reaction. Its action is thus described by Ure. Soon after it is applied a sense of warmth is felt in the part, which is quickly followed by severe burning pain, which continues for seven or eight hours, and subsequently by the death of the cauterized tissue. It forms a whitish eschar, which separates in the course of from eight to twelve days.¹ This caustic, says Vogt,² is useful because, if absorbed, it can do no injury, and it is therefore appropriate when large abnormal growths are to be destroyed. Nor does it produce a foul slough like the chloride of antimony, the caustic alkalies, &c., nor an inflamed sore with profuse discharge, but it leaves behind a clean granulating surface, discharging healthy pus, and tending rapidly to cicatrization. In this respect it resembles the nitrate of silver more than any other caustic.

USES.—This agent has been used *internally* in a great number of constitutional cachexiæ—syphilitic, scrofulous, scorbutic, cancerous, &c.; but the danger of its operation should dissuade from employing a remedy of such inferior, and indeed questionable, value.

Externally it has been recommended by Vogt as a very efficient application to ulcers in persons of a torpid and cachectic constitution, or whenever they present a foul and flabby look, and discharge an abundant thin and acrid matter. Canquoin used it extensively to remove cancerous tumors, &c., and he claims to have cured four-fifths of one hundred and twenty-six cases by its means. He made use of a paste of various strengths, containing one part by weight of the chloride to two, three, four, or five parts of flour. This, when formed into disks proportioned in size and thickness to the extent of the diseased part, was allowed to produce an eschar which varied from a line to more than an inch in thickness, according to the strength of the paste, the duration of its contact with the morbid tissue, and the firmness of this latter. After separation of the eschar a stimulant resinous plaster was applied. According to its proposer, the advantages of this treatment are, that the action of the caustic is limited to the diseased parts, that it is less painful than the arsenical paste, that it destroys the offensive smell of the sore, and that the wound left by it heals rapidly.³ Superficial cancerous ulcers have also been treated successfully, by Mr. Lawrence, McClintock, and others, with this caus-

¹ Lond. Med. Gaz., xvii. 571.

² Lehrbuch, 3tte Aufl., i. 335.

³ SOBERNHAIM, Handbuch der Pract. Arzneim.

tic.¹ In 1857 and 1858 the attention of English surgeons was drawn to the operation of a secret remedy proposed as a cure for cancer by an American named Fell, and which turned out to be ehloride of zine mixed with an inert vegetable powder. After attracting a great deal of notice, and having been thoroughly put to the test, the same conclusion was arrived at as on other occasions of its use, viz., that the efficacy attributed to it is illusory, that it does not act upon the skin while the epidermis remains whole, that its action is not complete in less than one or two days, and that it produces such intolerable pain that patients of the greatest fortitude are unwilling to submit to a second application of it.² These contradictory statements are doubtless both exaggerated. In spite, however, of the real value of this caustic in cancerous disease, it is certainly much less used, and is probably much less effectual and prompt in its action, than the arsenical paste. It has been applied to remove other abnormal growths. Caloway employed it for the destruction of *nævi materni*, and Haneke, of Breslau, for these tumors, for *fungous hæmatodes*, *malignant pustule*, &c.

ADMINISTRATION.—If used internally, a solution may be made of half an ounce of ehloride of zine to three fluidounces of spirit of sulphuric ether, and prescribed in doses of from four to eight drops twice a day.

For external application, when a powerful caustic operation is sought, the method of Canquoin, already indicated, is the best. When a more superficial action is desired, the concentrated solution may be applied by means of a brush until it excites a burning pain. In the case of indolent sores, applications subsequent to the first should be made with a weaker solution.

ANTIMONII ET POTASSÆ TARTRAS, vid. *Emetics*.

ANTIMONII TERCHLORIDUM.—TERCHLORIDE OF ANTIMONY.—BUTTER OF ANTIMONY.

PREPARATION AND PROPERTIES.—This substance is obtained by the action of liquid hydroehloric acid upon persulphuret of antimony. During the process sulphuretted hydrogen escapes, and a terehloride of antimony dissolved in hydroehloric acid remains. The latter is driven off by distillation.

¹ WALSHE, On Cancer, p. 219.

² TROUSSEAU and PIDOUX, *Thérapeutique*, 3ème éd., i. 413.

Terchloride of antimony is a transparent liquid, generally of a yellowish tinge, an oleaginous consistence, and a penetrating and acrid odor. When exposed to the air, it gives off thick grayish-white vapors, and becomes turbid.

ACTION.—Four cases of poisoning by this preparation are on record.¹ In three of them the quantity taken varied from two to five drachms, and all the patients recovered; in the remaining case, which was fatal, between two and three ounces were taken with a suicidal purpose. The principal symptoms were these: faintness, prostration, collapse, a cold and clammy state of the skin; dilatation of the pupils, a small accelerated pulse; vomiting, painful deglutition, pain in the epigastrium and abdomen, excoriation or ulceration of the fauces, œsophagus and stomach. In the fatal case the mucous membrane of the stomach and small intestine was completely destroyed, and appeared as if charred.

USES.—It is employed exclusively as a caustic. Although very searching, it does not occasion very severe pain nor much inflammation, but, owing to its liquid form, is apt to extend its action unduly. It produces a white eschar, which leaves, on separating, a clean and healthy surface. This caustic has been used to repress excessive granulations in ulcers; to extirpate chancres, carbuncles, and warts; to cauterize poisoned punctured wounds, such as those made by rabid animals and venomous reptiles; and to remove pannus, pterygium, opacity of the cornea, &c.

ADMINISTRATION.—This caustic may be applied by means of a camel's hair pencil. In affections of the eye it must be very cautiously employed, and any excess of it immediately washed away with milk and water.

If taken internally by accident or design, magnesia or some one of the alkaline carbonates should be administered at once, and vegetable astringents afterwards.

¹ TAYLOR on Poisons (2d Am. ed.), p. 489.

VEGETABLE IRRITANTS.

SINAPIS.—MUSTARD.¹

DESCRIPTION.—The seeds of the *Sinapis nigra* and *S. alba*. These are annual plants, and both of them natives of Europe. They are, however, cultivated in this country. Black mustard seeds are small, globular, rugose, of a reddish or blackish-brown color, without, and yellow within, inodorous when whole, but when crushed exhaling a strong and pungent smell; their taste is hot, bitterish, and somewhat unctuous. White mustard seeds are larger, of a yellowish color, and a less biting taste.

HISTORY.—Hippocrates² speaks of mustard as being hot and purgative, but apt to produce incontinence of urine. Dioscorides³ recommends it to be chewed to purge the brain of phlegm, and to be used as a gargle with honey and water for inflammation of the throat, and as a sternutatory in epilepsy and hysteria. He directs it to be applied to the shaven scalp in lethargy, as a rubefacient cataplasm mixed with the pulp of figs in sciatica, and for other pains, and generally as a counter-irritant. According to this writer, it promotes the growth of hair in bald places, acts as a cosmetic, and cures obstinate eruptions of the skin when mixed with ointments or with vinegar. It is taken in substance or mixed with liquid for intermittent fevers; it is also added to vesicating plasters and to those for scabies. Bruised and applied upon a fig behind the ears, it cures deafness and *tinnitus aurium*. Its juice, with honey, is recommended as a remedy for roughness of the eyelids and weakness of sight.

Archigenes, who lived in the reign of Trajan, wrote a treatise on the external use of mustard (*de sinapismo*), extolling it as a remedy for nearly all chronic diseases. He directed its application to the head in mania and epilepsy, and the use of suppositories containing it in paralysis of the rectum. He was also acquainted with the powers of vinegar to weaken the action of mustard, a fact that Aëtius also alludes to in these words, "*Acetum enim sinapis vim discussit.*" The first-named

¹ Mustard, from *mustum ardens*, because it was formerly manufactured from must, or new wine, and the powdered grains of the plant.—MÉRAT.

² De Dieta, ii. 25.

³ Mat. Med., ii. 148.

writer directed the medicine to be applied upon figs, or, if the skin was very sensitive, upon bread, and ordered the part to be first sponged with hot water, when the rapid action of the sinapism was desired. Cælius Aurelianus alludes to the emetic properties of mustard and advises it to be given with bread as a vermifuge.¹ Ruffus recommends the seed of mustard as a laxative.² Aretæus speaks of it as a stimulant and revulsive in chronic affections of the lungs, in tonsillitis, in headache, in apoplectic states of the brain; as an emetic in epilepsy; and of its use in poultices to hasten the discharge of chronic pleurisy when the fluid points externally.³ In his Commentaries, Matthiolus directs a poultice of bruised mustard seed, flour, and vinegar, as a remedy for the bites of serpents and scorpions, and an infusion of the seeds to relieve poisoning by mushrooms. He recommends it also as palliative for asthma, as diuretic, and as emmenagogue.

ACTION. *On Animals.*—The peculiar action of mustard depends upon the acrid oil developed in its seeds by their admixture with water or the process of distillation. The effects of this oil may be illustrated by the experiments of Mitseherlich, from which it may be inferred that—

1. Essential oil of mustard is a virulent poison. A drachm of it destroyed a rabbit in two hours, and half an ounce in fifteen minutes. Of all the oils hitherto tried, it is the most poisonous, even more so than that of bitter almonds.

2. It is absorbed; for its odor was perceptible upon the breath and in the peritoneal cavity of the animals opened immediately after death. The smell of the urine, on the other hand, was anomalous, and somewhat like that of horseradish.

3. The stomach and bowels were but slightly inflamed, but the vessels were gorged with thick and dark blood. The irritability of the heart and the other muscles continued for an unusual time after death.

4. The actual symptoms of the poisoning were these: Great frequency of the heart's action, speedy loss of sensibility and muscular power, feebleness of the heart's pulsations, difficult respiration, repeated convulsions, great insensibility, coldness of the external parts, and death.

On Man.—Mustard seed taken whole, and in doses of a teaspoonful three or four times a day, have a laxative action on the bowels, and are discharged without perceptible change. In a fatal case of peritonitis, the cause of the attack appeared to be a mustard seed lodged in

¹ STRUMPF, *op. cit.*, ii. 67.

² ADAMS, *Comm. on Paul. Æginet.*, iii. 264.

³ *Comp.*, lib. i. cap. 2 and 10; lib. ii. cap. 1, &c.

the appendix vermiformis. That such an event is one of not improbable occurrence is shown by the numerous instances in which small shot, cherry-stones, &c., have occasioned a similar accident.

Powdered mustard produces a peculiar prickling and lively burning when applied to the tongue, and moderately large quantities excite similar sensations in the throat and stomach. It promotes the digestion of food, but an habitual use of it, as of all the aromatic condiments, enfeebles the stomach. In larger quantities, and diffused through water, it serves as a prompt and efficient emetic, but care must be taken to evacuate the dose completely from the stomach, lest it cause inflammation of this organ. Van Swieten relates a case of neglect of this precaution, which terminated fatally on the third day.

In the form of sinapism, mustard produces, after the lapse of three or four minutes, an acute prickling and stinging pain, which afterwards grows burning, and seems to penetrate deeper and deeper. It has been compared to the pain of a red-hot iron held at a little distance from the body. A sensation is then perceived as if the part were being constricted or compressed, and is more tolerable than the former, but after a few minutes the burning pain revives and speedily grows insupportable. From the moment when pain is first felt the skin becomes red and rapidly inflames; this state augments, indeed, even after the removal of the sinapism. The redness generally remains for several days, after which the cuticle usually exfoliates; but the part continues to be very sensitive for a much longer period. The time necessary for producing these effects varies with the sensibility of the skin, but they are usually developed by less than half an hour's use of the plaster. Its longer contact vesicates the skin, and is apt to produce ulcers which are singularly difficult to heal. Sometimes the skin remains permanently discolored. Freshly-powdered mustard acts more rapidly, but not more efficiently, than what has been prepared for several months. As was remarked, the rapidity and the degree of action of sinapisms are proportioned to the delicacy of the skin to which they are applied. Hence the caution demanded in using them on females and young children. Their mischievous effects upon the latter have been pointed out by M. Valleix,¹ who remarked that the pain caused by them may become dangerous at an age when all strong impressions upon the nervous system are apt to be followed by cerebral excitement. Here the benefits of counter-irritation are purchased at a ruinous price. In his little work on *Infant Therapeutics*, Beck has also dwelt upon the dangers of incautiously using these remedies

¹ Bull. de Thérap., xxvii. 184.

in young persons, dangers which he illustrates by a case in which suppuration, gangrene, and death were produced by a mustard poultice applied by mistake to the swollen glands of a child's neck.

Some curious phenomena developed by general baths containing mustard have been pointed out by MM. Trousscau and Bonfils.¹ At a temperature of 86° F., the patients experienced wandering chills in the loins, the back, the abdomen, and limbs, followed by a decided sense of coldness in the loins and abdomen, and afterwards by shuddering, and shivering, slight twitching of the lips and limbs, and chattering of the teeth. The expression of the countenance changed, and the patients complained of suffering from cold. Meanwhile the skin remained at the temperature of the bath, and the pulse was but slightly accelerated. By degrees the skin gave evidence, by its redness, of the irritant action of the mustard, yet without any sensation of heat until after the patient had withdrawn from the water. Then reaction was established, and general heat of the surface with stinging and burning sensations was experienced.

Oleum Sinapinum.—Volatile oil of mustard was formerly procured in an impure state by expression merely, and was employed as a rubefacient in painful and spasmodic disorders. It seems to have been first used for medicinal purposes in a separate state in 1820, at Cadiz, and some years afterwards (1831) a saturated solution of the oil in water was employed. This oil is most usually obtained by distillation from black mustard seeds after the removal of the fixed oil by pressure. Water seems to be necessary for its extraction. This fluid is regarded as causing by its presence such a reaction between the myronate of potassa and the myrosyne of the seeds as results in the production of a volatile oil. White mustard seed contains myrosyne, but not the myronate of potassa; it has, however, among its constituents an analogous substance to this latter, which develops an acrid principle of feeble power, but of the same nature as that contained in the black variety. It is essential to the development of these acrid products that a low degree of heat should be employed. For hot water, alcohol, and the acids, equally prevent their formation by causing coagulation of the myrosyne.

Volatile oil of mustard is of a white or lemon color, and extremely acrid and pungent, exciting the secretion of tears when smelled. A single drop of it upon the tongue causes an insufferable burning pain, which extends to the nose, throat, and stomach. Upon the skin it acts promptly and severely as a caustic. Prevost applied some of it to the

¹ Bull. de Thérap., lv. 25.

shaven skin of a dog, and produced signs of extreme suffering, followed by the formation of a large blister.¹

The fixed oil of mustard is mild, inodorous, somewhat thicker than olive oil, and of an amber color. Its sp. gr. is 0.917. It forms a very hard soap, and acts as a purgative in doses of two ounces.

USES.—In that form of gastric disorder known as *atonic dyspepsia*, and which appears to be a simple debility of the digestive organs, mustard is advantageous both as a condiment and when taken in the whole seed. The latter is perhaps the preferable form when, as generally happens, the bowels are constipated. With their restoration to a healthy action the flatulence, oppression, nervous colic, &c., usually disappear. In this manner certain forms of nervous disease, and hypochondriasis particularly, have been greatly benefited.

Mustard is one of the most prompt and efficient emetics that can be used, and is peculiarly appropriate where it is desirable rather to stimulate than to depress the system. Such is the case in *narcotic poisoning*, for which this agent should always be employed in preference to the more usual ones. So, too, in that stage of *delirium tremens* when a timely emetic will cut short the attack, none is so appropriate as mustard. The late Dr. Joseph Klapp, of Philadelphia, had a large and successful experience in its use, and published striking reports of its efficacy.²

In *atonic dropsy*, Mead and others have extolled the virtues of mustard seed; but, except as an adjuvant to other and more active treatment, it is of no value in this affection. An infusion of this seed in cider has more to recommend it in the case in question, and mustard whey might probably conspire with it as a stimulant diuretic.

Chronic *pulmonary catarrhs*, attended with asthmatic symptoms, are said to be benefited by the use of mustard seed. The evidence upon this point is not, however, conclusive. Other and numerous remedies have more in their favor.

It has already been mentioned that mustard was successfully employed by the ancients in certain cutaneous disorders. M. Julia Fontenelle made use of water impregnated with the essential oil of mustard for the same purpose, and he reports twelve cases of scabies as having been cured by its means.³ A strong opinion in favor of the depurative action of this remedy is expressed by M. Trousseau, who asserts that, by continuing its use for a long time, he has cured, or put in the way of cure, cases of cutaneous disease and of rheumatism which nothing else benefited.

¹ WILMER, *Wirkung der Arzneim. u. Gifte*, v. 43.

² Phila. Med. Recorder, i. 462, 478.

³ MÉRAT and DE LENS, *Dict. de Mat. Méd.*, vi. 354.

But it is as an *external irritant* that mustard is best and most advantageously known. Here it may be used, like other local stimulants, to excite feeble parts, or to moderate excessive local action by withdrawing stimulus. The direct and simple stimulation of mustard is often serviceable by arousing the whole system from torpor or exhaustion, as in swooning, the insensibility of hysteria and its allied states, and in the coma of febrile or other affections in which the brain seems to be oppressed.

When the action of a part is morbidly diminished, the temporary application of mustard may be useful; as when an eruption is slow to make its appearance, or has receded after having broken out; when retrocession of specific inflammatory action to a vital organ takes place, as in gout and rheumatism; when the skin where leeches are to be applied is deficient in vascularity; or, finally, when a part becomes atrophied from disease or want of use, as the muscles of the limbs, for example.

But mustard is most generally used as a counter-irritant. Its speedy and temporary action is invaluable for relieving local pains of a neuralgic character, and those even of a congestive or an inflammatory origin, and provided that the inflammation be in its nascent stage, or of moderate activity. Hence in subacute and chronic rheumatism of the muscles and joints, in rheumatic toothache, earache, &c., in neuralgia produced by cold, in pleurodynia, flatulent colic, spasmodic and humid asthma, muscular cramps, congestion of the brain, arrested catamenia, the various forms in which mustard may be employed find a constant and successful application.

ADMINISTRATION.—Mustard does not lose much of its activity by keeping. Lukewarm or cold water does not, like hot water, impair its power, but vinegar has this effect very decidedly. Hence, when a sinapism of moderate activity is required, it may be prepared with vinegar, instead of being, as it usually is, diluted with wheat or rye flour. Even strong acetic acid mixed with mustard makes a weaker sinapism than if water is employed; still, such a preparation as the former may have advantages when a very speedy impression is required. Trousseau and Blanc state that white or English mustard is not so much impaired by vinegar as the dark variety is;¹ but this may perhaps be explained, according to Pereira, by the circumstance that English mustard is frequently adulterated with pod pepper, which is a powerful rubefacient. The irritant effects of mustard may be relieved by narcotic fomentations, by cold water, by simple unctuous

¹ Archives Gén., xxiv. 77.

applications, by lead cerate, or, still better, by the ointments of belladonna, stramonium, &c. One of the best palliatives is the linimentum calcis.

Of the seeds, a teaspoonful to a tablespoonful may be taken two or three times a day. The *infusion* of mustard is prepared by adding from ʒij to ʒj of the flour, to a pint of lukewarm water. *Mustard whey* is made by adding to a pint of milk and a quart of water, an ounce and a half of bruised mustard seed. The mixture is boiled until it is curdled, and is then strained. A wineglassful may be given every hour or two. The *sinapism* or mustard plaster is made by adding cold or lukewarm water to a sufficient quantity of mustard and wheaten or rye flour, and stirring until a thick paste is formed. This is spread upon linen or other convenient substance, and applied to the skin. It is well to interpose a piece of gauze between the plaster and the body, in order to prevent the former from adhering. If it does not produce pain or redness within a quarter of an hour, a stronger application should be made. When it is removed, the skin underneath should be washed with tepid water. When sinapisms are applied to persons in a state of insensibility, the skin beneath should be examined from time to time to secure it against excessive irritation.¹ The *mustard cataplasm* is an ordinary poultice in which mustard has been mixed; it is intended to produce a feebler but more prolonged action than the sinapism. *Sinapised pediluvia* are formed by adding a sufficient quantity of the flour of mustard to an ordinary foot-bath. A tablespoonful may be stated as the average quantity required. The *ethereal oil* of mustard has been prescribed internally in an emulsion. The dose is from $\frac{1}{2}$ to $\frac{1}{4}$ of a drop several times a day. The oil may be used externally as a rubefacient in the proportion of twenty-four drops to an ounce of alcohol, or of five or six drops to a drachm of oil of almonds. It may be applied by friction or by means of a rag saturated with either of the mixtures mentioned. Care must be taken to proportion the dose to the delicacy of the skin, and to apply it in a very diluted state only to the face or neck.

CAPSICUM.—CAYENNE PEPPER.

DESCRIPTION.—Cayenne, or Red Pepper, is the fruit of *Capsicum annum*, a native plant of South America, and one of the natural family of Solanaceæ. It does not possess any qualities, however, which

¹ "Verum ne pustulas vulneraque efficiendo periculum inferat, frequenter detrahendum est cataplasma."—ARETÆUS, De Cur. Morb. Acut., lib. i. cap. ii.

illustrate its botanical affinities. This plant bears a pendulous pod-like berry, of a bright red or orange color, containing seeds, and which, when dried and ground, forms the Cayenne pepper of commerce. As many as twenty-five species of capsicum have been described which possess in a certain degree the qualities of that under notice. It is maintained by some writers that the ancients were acquainted with this plant, but the grounds of this opinion and for supposing capsicum to be of Asiatic origin are believed to be untenable. It was first known in Europe early in the 16th century, and was brought thither from the then newly-discovered Western World.

PROPERTIES.—The odor of powdered capsicum is pungent and somewhat aromatic; its taste bitterish, fiery, and very persistent. These qualities depend upon a peculiar principle, *capsicin*, which possesses those of the fruit in a remarkable degree. "Half a grain of it volatilized in a large room causes all who respire the air of the room to cough and sneeze." When applied to the skin, capsicum excites redness of the skin, and ultimately vesication. When swallowed in moderate quantities it produces a sense of burning in the throat, and a grateful warmth in the stomach, while it at the same time seems to quicken the appetite and the digestive function. It is peculiarly adapted to promote the digestion of vegetable food and to correct its tendency to produce flatulence. Hence, doubtless, it is universally employed as a condiment in warm climates where fruit and vegetables form the chief aliment of the people. In large doses it produces a glow over the whole body and excites thirst, but it scarcely, if at all, quickens the pulse. After the habitual use of this condiment the signs of its local stimulation decline, and are followed by a proportionate debility of the stomach and bowels. Instances may, nevertheless, be frequently met with in which enormous quantities of capsicum are habitually taken without material injury, provided that no serious impairment of the constitution exists. Disciples of the Thompsonian quackery give daily proof of this. A writer¹ states that one of his friends who had resided for a long time in the East Indies, eat capsicum upon his bread and butter, the layer of pepper being equal to the butter in thickness.

Its stimulant action upon the urinary apparatus entitles capsicum to be ranked among the aphrodisiacs. Very large doses of it produce great derangement of the stomach in persons unaccustomed to use it freely. According to Vogt² the symptoms are violent purging and vomiting with severe colic, and even gastric inflammation, to which

¹ LUNGLISON, Mat. Med., ii. 407.

² Pharmakodynamik, 3tte Aufl. ii. 616.

Richter¹ adds nervous paralysis or debility, disturbance of the brain, intoxication, and vertigo.

USES.—The properties of capsicum as a condiment which have already been referred to, may be applied medicinally in many cases of feeble digestion, in such, for example, as are distinguished by flatulence and oppression after meals, and especially when symptoms of this description are connected with a gouty state of the system. Numerous writers mention capsicum as a valuable stimulant in low forms of fever, given either alone or in combination with excitants and tonics. Dr. Chapman indeed observes² that to seek a general stimulant effect from this medicine involves an incorrect estimate of its properties. The only indication which, in his opinion, it is capable of fulfilling is that of alleviating gastric distress in continued fever. But it undoubtedly does exert an indirectly stimulant action by enabling the stomach to convert appropriate food into nourishment at a time when, owing to its want of this power, the system is threatened with fatal prostration. Combined with turpentine, it increases the power of this medicine to promote or provoke the discharge of flatus from the bowels and thus to remove an incidental but often a very serious complication of typhoid diseases.

This medicine has been proposed as a means of curing *hæmorrhoids* by M. Allégre, and, according to a report made to the Academy of Medicine, with much success. It is administered in doses of from seven to forty-two grains.³ Dr. Buckingham states that he has found the pickled unripe pepper productive of similar results.⁴

Several writers state that capsicum has been successfully given in *intermittent fever*. Bergius prescribed it for this disease in substance and conjoined with laurel berries, and he declares that he frequently saw intermittent fevers cured by its means, and generally without relapse.⁵ Mr. Collins⁶ and Niemann⁷ also employed it with advantage. It forms an excellent adjuvant to quinia in this disease when the stomach is feeble and the digestion imperfect.

The most useful application of capsicum is in the treatment of *tonsillitis*, and particularly of that form which arises in some cases of scarlatina, and is known as *cynanche maligna*. Incipient tonsillitis may often be arrested at the outset by a strong gargle of Cayenne pepper; but if once the disease is fully developed, it is more hurtful than useful. It is also very efficacious in relaxed states of the mucous

¹ Ausführlich. *Arzneim.*, ii. 179.

³ *Bost. Med. and Surg. Journ.*, liii. 324.

⁵ *Mat. Med.*, i. 144.

⁷ RICHTER, *op. cit.*, ii. 181.

² *Elem. of Therap.*, ii. 143.

⁴ *Ibid.*, p. 366.

⁶ WILSON on Febrile Diseases, ii. 141.

membrane covering the uvula and fauces. The practice of employing it in the ulcerated sore-throat of scarlet fever originated with the West Indian physicians, who used very successfully a preparation described below, "for a kind of angina maligna prevailing among the children of St. Vincent, which began with blackness, sloughiness and ulceration of the fauces and tonsils without fever."¹ Mr. Stephens gave it to four hundred patients laboring under this disease, and it seemed "to save some whose state had been thought desperate." Kreysig, Headley, Currie, Collins, and others, employed the same or a similar preparation in the malignant sore-throat of scarlet fever. As children are seldom able to use it in the form of a gargle, the infusion or the tincture of capsicum may be applied to their throats by means of a piece of sponge attached to an appropriate handle.

Capsicum has also been used advantageously for *sea sickness* in the dose of a teaspoonful, given in some convenient vehicle on the first occurrence of nausea.² In the advanced stages of *rheumatism* it has also been recommended, and very probably upon good grounds; for in the chronic and non-febrile forms of the disease it is well known that stimulants, as well internal as external, have been used with success.

ADMINISTRATION.—Powdered capsicum may be given in the dose of from five to ten grains in the form of a pill. An *infusion* made by adding two drachms to half a pint of boiling water may be prescribed in the dose of a tablespoonful. The infusion, referred to above as having been successfully used in angina maligna, may be prepared as follows: Take two tablespoonfuls of red pepper and the same quantity of fine salt, beat them into a paste, and add half a pint of boiling water. Strain off the liquor, when cold, and add to it half a pint of very sharp vinegar. Of this the dose for an adult is a tablespoonful every half hour. The extreme acrimony of this preparation renders it difficult to be administered, and its effects upon the throat are very irritating, but when this part is occupied by sloughs the medicine hastens their separation and promotes the healing of the ulcers which remain.

OLEUM TEREBINTHINÆ.—*Oil of Turpentine.* Vid. *Stimulants.*

PIX ABIETIS.—BURGUNDY PITCH.

DESCRIPTION.—"The prepared concrete juice of *Abies excelsa*." This tree is a native of Europe and Asia, and abounds in the forests

¹ LEWIS, Mat. Med., ii. 494.

² U. S. Dispensatory.

upon the northeastern limits of France, in what was formerly the province of Burgundy. The resin is obtained by means of scarifications made in the bark of the tree. It is opaque, brittle, whitish or yellowish, of a weak terebinthinate taste and odor, softens at the temperature of the body, and adheres strongly to the skin.

ACTION AND USES.—When applied to the skin in the form of a plaster it acts very slowly as an irritant, producing redness or a papular eruption accompanied with a good deal of itching, and sometimes, particularly if the skin be delicate, a vesicular and even a pustular eruption with superficial ulcers. In some persons, and perhaps during certain epidemic constitutions, it occasionally gives rise to an erysipelatous inflammation of the skin.

Burgundy pitch is one of the most useful of the revulsive agents, whether it is employed alone, or as the basis of various plasters which are employed in the daily treatment of chronic diseases. It is in fact a popular remedy among the laboring classes for those rheumatic affections of the lumbar and other muscles of the back to which persons are peculiarly exposed who work in a stooping posture and in the open air. Hence the plasters made with it are vulgarly called *strengthening plasters*. Another and scarcely less valuable application of these plasters is in chronic affections of the chest. They act very beneficially by diminishing the sputa in phthisis, by preventing to some extent the intercurrent and subacute inflammations of the lungs which hasten the decline of this disease, by relieving the neuralgic pains of the chest which are apt to exist at the same time, and by affording some protection against the impression of external cold. In chronic pleurisy it is probable that, either in their simple form or rendered more stimulating by the addition of cantharides (Emplast. Picis c. Cantharide), they contribute to hasten the absorption of the effusion, as well as to diminish local pain. They may be applied between the shoulders, over the sternum, or upon the lateral regions of the chest, and should always be of large size. For other local pains these plasters are of use, but inferior, for the most part, to other rubefacient and anodyne applications. One case, however, is mentioned by M. Trousseau, of which a passing notice may be taken. Sciatica, it is well known, is an extremely rebellious disease, and M. Trousseau asserts that he has seen it cured by enveloping the whole thigh in a Burgundy pitch plaster, after blisters and the endermic use of morphia had failed. The method was derived from an extra-professional source, but we can readily understand why the superficial irritation of the plaster should have been more successful than blisters applied as those referred to probably were, in such a manner, that is, as to produce

copious suppuration. Superficial vesication by cantharides as rarely fails to cure this disease as deep vesication does to aggravate it.

In chronic inflammation of the bowels the steady counter-irritation of a Burgundy pitch plaster often proves effectual in removing the last traces of the disease; but the application is a difficult one to make upon so movable a surface as that of the abdomen.

MEZEREUM.—MEZEREON.

DESCRIPTION.—This is the bark of *Daphne mezereum* and *D. gnidium*. The former is a native shrub of Europe, where it grows from north to south, in light calcareous soils, as an underwood in forests and thickets. It bears clusters of very fragrant flowers, of a white or pale rose color, and a bright red, shining, and fleshy berry. The *D. gnidium* belongs to the south of Europe, and has a very different aspect. Its berry is at first green, but afterwards becomes black. Mezereon bark, "as it comes to us, is usually in strips from two to four feet long and an inch or less in breadth, sometimes flat, sometimes partially rolled, and always folded in bundles or wrapped in the shape of balls. It is covered externally with a grayish or reddish-brown wrinkled epidermis, very thin, and easily separable from the bark. Beneath the epidermis is a soft greenish tissue. The inner bark is tough, pliable, fibrous, striated, and of a whitish color. When fresh it has a nauseous smell, but in the dry state is nearly inodorous. Its taste is at first sweetish, but afterwards highly acrid, and even corrosive. It yields its virtues to water by decoction."¹ The active principle of the plant is supposed to reside in *mezerin*, an acrid resin, which, by its union with fatty substances, forms mezereon ointment.

HISTORY.—*Daphne mezereum*, according to Strumpf, appears to have been less used by the ancients as a medicine than *D. gnidium*, although Diokles employed the berries of the former to prepare a gargle for putrid sore-throat. Tragus gave the first good account which we possess of the former variety, and he states that its flowers are useful in dropsy. Subsequently the leaves, and the bark of the trunk, branches, and roots, were held to be cholagogue, and as useful in expelling morbid secretions generally. They were much used as a secret emmenagogue. Many writers, and among them Ambrose Paré, held mezereon to be one of the best remedies for the plague, as well as to counteract the effects of animal poisons, when it was employed in such

¹ U. S. Dispensatory.

a manner as to produce copious evacuations from the alimentary canal and from the skin. In Siberia women and effeminate men are said to employ the berries for the purpose of bringing color into their cheeks. Russian peasants take as many as thirty of them at a dose for a purge, and give them to children as an emetic in whooping-cough. The Finlanders use them also for intermittent fever. According to Villars, even in Dauphiny the peasants will take eight or ten of the berries as a purgative dose. Leroy, in 1767, was the first to call the attention of physicians to the value of the bark as an epispastic, a fact which he had learned from the peasants of the district of Aunis.¹ A certain Schlegel used a secret remedy for chronic ophthalmia which consisted in pieces of mezereon bark worn in holes punctured in the lobe of the ear. In Russia, according to Pallas, it is employed as a remedy for toothache.²

Daphne gnidium is thought to be the species particularly described by Dioscorides under the name of *Chamelæa*. He describes it as a drastic and hydragogue cathartic, and as very irritating to the fauces, and says that with nitre and vinegar it excites sweating. Matthioli makes very similar statements, and confirms them by examples of dangerous vomiting and purging caused by this plant. Neither of these authors alludes especially to the bark as being used in medicine.³

ACTION. *On Animals.*—According to Linnæus, six berries destroyed a wolf. Lange saw a scruple of the same, in powder, kill a dog, and the mucous membrane of the animal's stomach was swollen and studded with bloody points. In horned cattle it produces bloody purging. But six berries given to a rabbit produced no effect. Gmelin states that bees carefully avoid the flowers of this plant. Birds, on the other hand, are said to eat the berries without harm, and without their flesh becoming poisonous.⁴ The experiments of Orfila on dogs do not appear to have given rise to the ordinary phenomena of poisoning by mezereum. The animals neither vomited nor were purged, but perished by gradually drooping and pining. The intestinal mucous membrane was inflamed in the manner already described.

On Man.—Eating a few berries is sufficient to excite very severe pain in the stomach, vomiting, and violent diarrhœa. Brandt and Ratzeburg report that a child vomited inordinately after eating two of them. Lange states that the peasants of Brunswick employ it as a purgative, eight grains of the powdered seeds being sufficient to produce twenty evacuations, and also that the women often produce abor-

¹ JOURDAN, Dict. en 60 vol., art. Garou. ² MÉRAT and DE LENS, op. cit., ii. 584.

³ Comment. sur Dioscoride, iii. ch. 167; vi. ch. 33.

⁴ WILMER, Die Wirkung der Arzneim. u. Gifte, ii. 284; MÉRAT, art. cit.

tion by its use. A child, four years of age, who had eaten some mezereon berries, experienced a sense of burning in the mouth, and general distress, and, after some milk had been taken, vomiting ensued, and great thirst. The fauces were very much injected. In the course of an hour complete narcotism succeeded, the eyeballs were turned upwards, the pupils were contracted and insensible, and the muscles of the limbs twitched; but there was neither diarrhœa nor diuresis. The symptoms soon disappeared under treatment. A more serious case is the following: A hardy peasant, who was much troubled with hæmorrhoids, took forty berries as a laxative. He was soon attacked with very severe colic, continual vomiting, and almost incessant purging with bloody and slimy stools. Complete prostration ensued, with giddiness and disturbance of the head. On the following day his face was pale, cold, and collapsed, and the pupils dilated; he recognized no one, and suffered unquenchable thirst, with burning heat in the mouth, fauces, œsophagus, and stomach. The epigastrium, and indeed the whole abdomen, was painfully sensitive to the slightest touch. The voice was unnatural, weak, and tremulous; the breathing anxious, laborious, and short; the pulse very frequent, unequal, hard, and concentrated; the urine acrid, and blood red; the limbs cold, and the whole body covered with a cold sweat. The patient recovered after a cautious antiphlogistic treatment of four weeks' duration.¹ Death has sometimes been the consequence of an excessive dose of the medicine, and has been preceded by convulsions, syncope, and copious mucous discharges from the bowels, vagina, and bladder. After death inflammation of the gastro-intestinal mucous membrane has been detected.

The bark, when chewed, is not at first pungent to the taste, but in a little while excites a burning heat in the mouth, which lasts for many hours. In medicinal doses the decoction stimulates the salivary glands to copious secretion, and promotes discharges from the mucous membranes and the skin. Diarrhœa is apt to occur if the bowels are easily moved. The saliva and the other secretions are said to acquire a peculiar odor. Larger medicinal doses resemble in their effects those above described as poisonous.

The skin is very susceptible to the action of mezereon. When fresh, or when softened by soaking in water, the bark acts as a rube-facient, and at length occasions vesicles, which sooner or later discharge copiously a watery fluid, and leave behind moist, painful, and offensive sores, which not unfrequently are surrounded with pustules, and are extremely difficult to heal. The juice of the leaves, when rubbed upon the cheek of a girl of fair complexion, produced a burning pain,

¹ STRUMPF, *op. cit.*, ii. 498.

and swelling of the whole face, especially of the nose, eyelids, and forehead, which soon assumed the aspect of erysipelas with vesicles. To these symptoms were added a constant, violent, and painful sneezing and obstruction of the nostrils. Delirium followed, with a dull, insufferable, tensive pain in the temples, tormenting dryness of the fauces, cough, fever, and scalding and high-colored urine. Antiphlogistic means subdued the inflammation, and the cuticle of the affected part exfoliated. The patient, however, remained feeble, spiritless, and almost imbecile. She was soon attacked with typhoid fever, which, after a protracted course, merged into hectic, and terminated fatally nine months after the original symptoms.

USES.—As an internal medicine, mezereon is employed chiefly in compound decoctions for diseases of the skin, and especially in the secondary forms of syphilis affecting this tissue, the periosteum, or the bones. According to some writers its efficacy is less decided in purely syphilitic affections than in those which have been regarded as a consequence of a mercurial course of treatment. In 1769 Russell published¹ a number of cases intended to illustrate the power of the medicine in secondary syphilis, and they do indeed show that it is probably not without some influence on the nocturnal pains and periosteal swelling which belong to this affection. But it does not seem to have been really and radically curative in a single instance. Its use was almost always followed by that of corrosive sublimate. From its effects in some old syphilitic complaints, Eberle was inclined to attribute to it considerable remedial virtues.

In cutaneous affections of long standing, and not of syphilitic origin, but depending rather upon a torpid state of the system, the preparations of mezereon have enjoyed some reputation, but upon insufficient grounds, because the medicine was always used in combination with others more powerful than itself. Cullen, Pearson, Parry, and others, speak favorably, but not very emphatically, of its usefulness in this class of diseases. A review of their cases renders it probable that its efficacy was almost entirely limited to instances in which a rheumatic element predominated. In these, and in chronic gouty affections of the joints, attended with periosteal thickening and stiffness, Vogt regards the medicine as having been useful.²

Loebenstein Loebel insists upon its advantages in asthenic croup, as a substitute for seneka, on account of its greater promptness and certainty of action. But Sachse very properly objects to using so violent an emetic for young persons.³

¹ Med. Obs. and Inq., iii. 189.

² Pharmacodynamik, ii. 324.

³ Ibid., 325.

The medicinal action of mezercon is more clearly manifested by its external operation as a counter-irritant. Its power of exciting a strong, steady, and permanent irritation of the skin is constantly made use of for the purpose of supplying the place of cantharides, or of keeping up the less permanent action of the latter. In protracted diseases, therefore, or in those the nature of which is to run a tedious course, the derivative action of mezcreon is most frequently invoked. It is also employed as a stimulant to improve the action of foul or ill-conditioned ulcers. Peas impregnated with the alcoholic extract of meze-reon are used for the purpose of maintaining the discharge from issues.

ADMINISTRATION.—The officinal decoction affords the most convenient mode of prescribing this medicine for *internal use*. The dose is from four to eight fluidounces three or four times a day.

Externally, and to vesicate the skin, the recent or even the dry bark may be used. The former stripped of its epidermis is applied by its outer surface upon the skin which should first be bathed with vinegar. A compress and bandage is required to bring it into close apposition with the body. From twenty-four to forty-eight hours are necessary for its full effect, and a fresh piece of the bark should be applied every morning and evening. If it be intended to maintain the first impression, fresh portions of bark ought to be used every day, care being taken, however, not to allow the inflammation to extend too deeply. The dry bark, if not too old, will produce similar effects, but must first be soaked in water to render it pliable. Once the discharge has been set up, it may be sustained by mezcreon ointment. In general, however, and in this country almost exclusively, the mezereon ointment is employed, and only for the purpose of maintaining a discharge from surfaces made sore by cantharides, caustics, and other irritants. Unless some good reason to the contrary exist, cantharides is always used to establish the suppuration when a considerable surface is to be affected, and as soon as the purulent discharge slackens it is renewed and maintained by mezereon ointment.

Treatment of Poisoning by Mezereon.—The stomach should first be evacuated by means of copious albuminous or mucilaginous drinks given lukewarm. Milk and fatty oils may also be administered; vegetable acids, and albuminous clysters, if purging occurs; emollient and cool poultices to the abdomen; sinapisms to the extremities; and if there are signs of local congestion, depletion may be cautiously resorted to.

PYRETHRUM.—PELLITORY.

The root of the *Anthemis pyrethrum* (Linn.), which is a native plant of Barbary and Asia Minor. It is found in commerce in cylindrical pieces of about the length and thickness of the little finger, wrinkled longitudinally, of an ash-brown color externally, and breaking with a resinous fracture which is white and has a radiated appearance. It is inodorous, and when chewed has an acrid taste, and excites a burning and prickling sensation in the mouth and fauces, with a copious discharge of saliva. Its taste was compared by Linnæus to that of senega. Its acrimony depends upon a peculiar principle, *pyrethrin*.

Pellitory is a powerful local irritant, and acts upon the skin as a rubefacient.

Owing to its sialagogue properties it has been much used to relieve local pains about the face and head. Boiled in vinegar and applied to the cavity of carious teeth, it is said to relieve toothache. In paralysis of the tongue and pharynx, and in relaxation of the uvula, it may be used as a masticatory or in a gargle. Its powder may be employed as a sternutatory in chronic inflammations of the frontal sinuses.

ADMINISTRATION.—Its *dose* as a *masticatory* is from thirty grains to a drachm.

SABINA.—SAVINE.

DESCRIPTION.—“The tops of the *Juniperus sabina*,” a native evergreen shrub of Southern Europe. It is reported also to grow wild in the neighborhood of our northwestern lakes. The name of the plant is said to be derived from the Sabine territory, where it abounds.¹ The leaves as well as the tops are used in medicine. They have a peculiar, strong, heavy, and unpleasant odor, and their taste is bitter, acrid and disagreeable. These qualities depend upon the presence of a large quantity of an essential oil, which is obtained by distillation. The leaves impart their virtues to alcohol and to water.

MEDICAL HISTORY.—Of ancient writers, Dioscorides was the first to describe the qualities of *savine*.² The leaves, he says, are capable of arresting the progress of phagedenic ulcers; they form with honey an excellent cosmetic, and promote the cure of carbuncles. An infusion of them in wine causes bloody urine, and applied as a fomentation to the belly of pregnant women they produce abortion. The account given

¹ MÉRAT and DE LENS, Dict., iii. 695.

² Liv. i. ch. 88.

by Galen is very much to the same purpose. He dwells particularly on its use in gangrenous sores of an indolent character, and states that on account of its volatile constituents it excites the menses more powerfully than any other agent, provokes bloody urine, destroys the life of the foetus, and causes its expulsion.¹ Very similar virtues are ascribed to savine by Rhazes and other Arabian writers, one of whom warns against the use of the medicine, by females of an ardent temperament. Another recommends a preparation of it in vinegar, as a remedy for alopecia.² Other ancient authors speak of the use of savine ointment in chronic gout and rheumatism. But it was most celebrated for its emmenagogue properties, which were habitually invoked for the criminal purpose of destroying the product of conception in order to conceal incontinency, or to escape the incumbrance of a family. In later times this property has been denied to savine by various authors of weight and reputation, but the proofs of its reality are unequivocal and conclusive.

ACTION. *On Animals.*—Orfila's experiments in which the powder of savine was introduced into the stomach of dogs, prove it to be a powerful irritant, causing severe pain, inflammation of the gastro-intestinal mucous membrane, and death. When applied to a wound made in a dog's thigh, it produced violent inflammation of the limb, with serous infiltration, followed by the animal's death.³ Mr. Letheby⁴ gave two drachms of powdered savine mixed with food to a small terrier dog. In two hours and a half it began to vomit, and continued to do so at intervals for an hour and a half. It then lay down exhausted, and in two hours afterwards was found in the same position, insensible, and comatose, with a slow laboring pulse. In this condition it remained for eight hours, passing a good deal of blood by stool. At the expiration of fourteen hours from the commencement of the experiment, the animal died. The brain was found gorged with blood; the lower bowels were highly congested and contained blood.

The German horse dealers are said to administer this substance to their animals for the purpose of making them lively and spirited. According to Hillefeld, a drachm of oil of savine given to a male cat produced a discharge of bloody urine, and after the animal's death the bladder contained blood, and its lining membrane was ecchymosed.⁵ Mitscherlich's experiments prove that *oil of savine* is a powerful poison. It is absorbed into the system, for its odor can be detected in the cavities of the body and in the blood, as well as in the breath and urine.

¹ EBN BATTHAR, i. 6, 7.

² Ibid.

³ Toxicologie, 5ème éd., ii. 130.

⁴ Lancet, June 7th, 1845.

⁵ MITSCHERLICH, ii. 659.

The intestinal lesions it produces are not in themselves mortal, for they seldom extend beyond vascular congestion, and an abundant exfoliation of epithelium. The kidneys are greatly congested, and muscular irritability continues for a long time after death. The symptoms, as observed by Mitscherlich, were as follows: the movements of the heart and thorax were hurried; in one experiment the urine was several times voided, dulness and insensibility supervened, the extremities were paralyzed, the respiration labored, the pulse could not be counted, and death took place after a very protracted struggle.

On Man.—When savine or its volatile oil is applied upon the skin or upon the surface of wounds, it produces inflammation, but more slowly than mustard or its essential oil. When the back of the hand is kept moistened with a few drops of the oil of savine, a moderate degree of prickling is felt after the lapse of ten or twelve minutes; but at the end of an hour, even, the sensation is not strong, and there is scarcely any redness.

Internally small doses of the leaves or of the oil do not give rise to any striking phenomena; at most they slightly augment the discharge of urine. Moderately large doses are apt to produce some disturbance of the stomach; but if they are repeated, arterial excitement ensues, the quantity of urine and the desire of voiding it are both increased, and the menstrual flow is apt to be brought on, or, if present, to be augmented. Still larger doses produce general distress, pain in the stomach, vomiting, diarrhoea, strong excitement of the circulation, and local sanguineous congestions. Sometimes the urine is bloody. In cases of still greater or of mortal violence the stools also are bloody, and symptoms of intestinal inflammation are developed. In pregnant females, abortion is apt to occur. After death, inflammation of the intestines is discovered, and sometimes congestion of the brain.

A case is reported by Mohrenheim of a pregnant female who took an infusion of savine to produce abortion.¹ It caused incessant vomiting, and some days afterwards excruciating pains, abortion, flooding, and death. Rupture of the gall-bladder was found on examination of the body, and an effusion of bile in the abdominal cavity with peritonitis. Many other illustrations might be adduced of the extreme danger to life of using large doses of this medicine. In most of them, signs of a violent inflammation of the intestinal mucous membrane and of the peritoncum were detected after death. Notwithstanding the almost certainly fatal consequences of producing abortion by means of savine, there is reason to believe that it is much more frequently

¹ MURRAY, *Apparat. Med.*, i. 59.

employed than is commonly imagined for criminal purposes, but fortunately in such doses as fail of their purpose and only produce instead, severe vomiting and purging.

Kopp relates the case of an infant who died from inhaling the fumes of a bottle of oil of savine which had been left open near its cradle all night, after having been used to bathe the child's hip.¹

USES. *Uterine Derangements*.—Savine is particularly called for in cases for which uterine stimulants are appropriate, but as it is perhaps the most powerful agent of the class it must be very circumspectly used. Nearly all writers of enlarged experience concur in attributing to the medicine very decided emmenagogue powers. According to Cullen, it shows a more powerful determination to the uterus than any other plant he had employed.² The cases of *amenorrhœa* to which it seems most appropriate are thus described by Vogt.³ They occur in persons of a torpid and relaxed constitution, and disposed to mucous accumulations and blennorrhœal discharges; in other words, there is a general atony of the system in which the uterus participates, and of which the capital sign is leucorrhœa occurring exclusively or in an aggravated degree about the catamenial period. Under these, or very similar circumstances, Pereira declares that savine "is the most certain and powerful emmenagogue of the whole materia medica." He gave the oil a preference over all other preparations in treating amenorrhœa, and in doses of from two to six drops diffused in a mucilaginous or oleaginous mixture. Kopp recommended savine as a very effectual remedy for *dysmenorrhœa*, particularly in unmarried females,⁴ and when it is attended with expulsive pains and the discharge of scanty, dark, and clotted blood, or when, as in other cases, there is an augmented flow taking place irregularly, ceasing, then reappearing, &c. He usually prescribed it in conjunction with borax, and, when there was a great want of tone in the system, added bark, iron, and other tonic medicines. The same writer extols the efficacy of savine in sterility depending upon a torpid state of the sexual organs of the female. He states also that it acts as an excitant of the venereal propensity, and relieves menorrhagia when this latter depends upon a chronic passive congestion continuing after delivery.⁵ Wedekind, Gunther, and Sauter, have also furnished numerous proofs of its anti-hemorrhagic virtues in cases of undue menstruation, and of threatened abortion depending upon a presumed inertia of the uterus.⁶ The

¹ RICHTER, *Ausführlich Arzneim.*, suppl. Bd., 408.

³ *Pharmacodynamik*, ii. 182.

⁵ RICHTER, *loc. cit.*

² *Mat. Med.*, ii. 366.

⁴ *Ibid.*

⁶ DIEU, *Mat. Med.*, iii. 260.

dose employed for this purpose was from five to fifteen grains of the powder given three times a day, and that for several months together.

M. Aran has published several cases which serve to strengthen the grounds of this doctrine.¹ He says that, strange as it may appear, this powerful emmenagogue has the property of suspending uterine hemorrhages. Some writers have spoken of the efficacy of savine in chlorosis, but this effect is doubtless secondary and indirect, depending upon its power of regulating the menstrual discharge, by the suppression of which a chlorotic state is very commonly prolonged, if not occasioned.

Savine has been also used successfully for the relief of *atonic gout* and *rheumatism* of long standing, and occurring in persons of a cold and phlegmatic temperament. Friction of the affected joints with oil of savine, or with an infusion of the tops of the plant, or with savine ointment, may be employed. It probably has no superiority over any other rubefacient application, when applied externally, but it is also, according to Hufeland, one of the most effectual of all internal remedies for chronic gout. He directed from twelve to twenty-four grains in the twenty-four hours, or a decoction made from twice that quantity.

Savine is also an excellent *vermifuge*, but not more so than other less injurious agents. Ray recommended a decoction of the leaves, or their expressed juice to be given with milk. Other writers have prescribed the same preparations as enemata to destroy ascarides of the rectum.

Savine is *contraindicated* during pregnancy, and whenever the circulation is readily excited it cannot be administered without risk. Every tendency of blood to the head, or lungs, or any local congestion or inflammation whatever, should form a sufficient ground for withholding it.

External Application.—Savine is used to excite, or more generally to prolong, a discharge from the skin after vesication by cantharides. It is also employed to destroy *venereal warts* and other excrescences by causing ulceration of the skin around them. It was recommended for this purpose, in 1553, by Ferrus, and subsequently by numerous other writers upon the venereal disease, who direct it to be applied in powder to the warts after they have been moistened. Others have prescribed it mixed with mercurial ointment. Vidal recommends equal parts of savine and burnt alum,² and Christison, like proportions of savine and verdigris. Its preparations continue to be used, as in ancient times, for hastening the discharge of the *gangrenous* portions of ulcers, &c., and generally for promoting suppuration whenever this

¹ Bull. de Thérap., xxx. 61.

² Ibid., xxviii. 477.

process requires quickening. In gangrenous sores it has been recommended mixed with camphor.

ADMINISTRATION.—Freshly gathered savine is by much the most effectual. It may be administered in *substance* in the form of powder, and in doses of five or six grains repeated three or four times a day, and gradually increased to a scruple. Owing to the difficulty of pulverizing it, Eberle suggests, as a convenient form of administering savine, to beat it up with honey, or any proper syrup, to the consistence of a conserve. An *infusion* may be prepared by digesting one draehm of the fresh herb in half a pint of boiling water. The *oil* may be given in doses of from two to five drops. The *cerate* is officinal.

OLEUM TIGLII.—See CATHARTICS.

OLEUM MONARDÆ PUNCTATÆ.—OIL OF HORSEMINT.

DESCRIPTION.—Horsemint is an indigenous plant found abundantly in the middle and southern States of the Union. The whole herb is employed. It has an aromatic smell, and a warm, pungent, bitterish taste. It is used as a domestic remedy for flatulent colic, nausea, and by the country folk as an emmenagogue, and also to cure intermittent fever. It is more valuable on account of the essential oil in which it abounds, and which is an active counter-irritant. Atlee, by whom attention was first directed to its qualities,¹ states that the smallest drop immediately diffuses a pungent, aromatic heat over the tongue and fauces, which remains a considerable time, and that when applied to the back of the hand, it excites redness, heat, pain, and vesication. He also used it diluted with alcohol as an embrocation in chronic rheumatism, and in a pure state to produce vesication of the back of the neck in a patient affected with mania-a-potu. In a case of partial deafness it was rubbed upon the scalp, and perfectly restored the hearing; in neuralgia, a liniment, in which it was associated with tincture of camphor and laudanum, afforded speedy relief, and the same was also used with advantage in hemiplegia and other paralytic affections. Its stimulant effects were shown during an epidemic of typhus, in which it counteracted the tendency of the extremities to grow cold, and also in cholera infantum when its application by friction to the abdomen restrained the tendency to collapse, and very

¹ Am. Med. Recorder, ii. 496.

generally relieved gastric irritability. The latter statement is confirmed by Eberle.

ADMINISTRATION.—Oil of horsemint should generally be used in a diluted state, even as a rubefacient. Internally it may be given in the dose of two or three drops mixed with sugar and water.

ANIMAL IRRITANTS.

CANTHARIS.—CANTHARIDES.

CANTHARIS VITTATA.—*Potato Fly*.

DESCRIPTION.—*Cantharis vesicatoria* is a native insect of the southern parts of Europe, but is now found in all the countries of that quarter of the globe. For commercial purposes, it was at first chiefly derived from Spain, and hence acquired its popular name. A Russian variety is said to be the most powerful of all. This insect is found upon trees and shrubs, and especially upon the ash, lilac, and privet; it is also, but more rarely, obtained from the rose, the plum-tree, &c.

The officinal species is from half an inch to an inch in length, by about two lines in breadth. It is distinguished by its beautiful wing-cases, which are iridescent, but the predominant colors are a brilliant and beautiful golden green. When alive, cantharides exhale a strong, fetid, and penetrating odor, by which they readily betray their presence. It is so offensive, that public walks frequented by them are deserted until their season has passed away. Their taste is acrid, terebinthinate, and even caustic. To this day, the mode of catching and preserving them for use is nearly the same as that described by Dioscorides, and which is mentioned below.

Several species of *Mylabris* and *Meloë* exist, whose properties resemble those of the officinal cantharis. The latter was unknown to the ancients, who probably employed species of *Mylabris*, some of which are to this day used for blistering in the East. This is evident from the fact that the insects mentioned by Dioscorides are described as having their wings marked by transverse yellow bands. This is a distinctive mark of a species of *Mylabris*, but does not belong to cantharides. Several American species exist, which possess powers

quite equal to those of the Spanish fly. One of these was described by Dr. Isaac Chapman, in 1805, and is now officinal. It is a native of Pennsylvania, and is known as the *C. vittata*, or potato fly. The *C. cinerea*, *C. marginata*, *C. atrata*, *C. Nuttali*, and *C. albida*, are all native species, and are strongly endowed with vesicating properties. The last two, especially, might well be substituted for the officinal insects.

The researches of Robiquet, in 1810, and of others, demonstrated the sources of the active properties in cantharides. They are, first, a highly poisonous and very volatile oil, of a greenish color, but which possesses no vesicating properties, and, second, a substance to which Thompson gave the name of *cantharidin*. Upon this latter, the power of the insect as a vesicant depends. It is regarded as a concrete volatile oil. Its color is white, and it forms shining, crystalline, and micaceous scales, which are vaporizable by a strong heat. In its pure or isolated state, cantharidin is insoluble in cold water or alcohol, but in its natural state, either of these liquids may acquire its properties. It dissolves readily in ether and in oils. M. Dieu estimates its power as fifteen times greater than that of cantharides. Cantharidin has also been obtained from *C. vittata*, *Mylabris cichorii*, and from different species of Meloë.

MEDICAL HISTORY.—Hippocrates¹ mentions first among the medicines which promote the menstrual discharge, “five cantharides from which the wings and legs have been removed.” It is said that these parts were rejected, not, as had been believed, because they were inert, but on account of their extreme acridity. According to Nardo, the vesicating principle resides chiefly in the wing-cases. Mérat and De Lens, however, affirm that the original opinion is the correct one, and that the parts referred to are really inert. Hippocrates also speaks of the use of cantharides in dropsy, amenorrhœa, leucophlegmatia, and jaundice, and of their external action in hydrometra. Dioscorides describes the manner of killing the insects (cantharides, buprestes) for preservation. They are either placed, he says, in an earthen vessel, the mouth of which, after being covered with a thin cloth, is inverted over another vessel containing boiling vinegar, or else held in a sieve over a pan of hot coals.² They are, he states, of a corrosive nature, causing inflammation and ulceration, and hence are used along with medicines that cure diseases of the skin, and cancer. They act as an emmenagogue when applied upon a pessary. Some, it is further remarked, attribute to them anti-hydropic virtues, because they are diuretic. Pliny and others state that the wings and head, when taken in

¹ Edit. VAN DER LINDEN, ii. 375.

² Op. cit., ii. 54, 55.

liquids, are able to counteract the poisonous effects of the bodies of these insects. The naturalist just mentioned alludes to their causing violent pains of the bladder, and relates that a certain Roman knight was killed by taking them for a lichenous eruption. He adds, however, that they are unquestionably useful when employed externally.¹ The poisonous effects of cantharides are thus described by Dioscorides.² The patient feels a gnawing pain in every part from the mouth to the bladder. He perceives a tercbinthinate taste in the mouth, and heat of the right side of the præcordium. The dysury and hæmaturia are great. The stools resemble scrapings of the intestine, as in dysentery. There is always nausea, fainting, spasms, and at last delirium. For this condition the author recommends oily and mucilaginous drinks, and enemata. Arabian authors afterwards prescribed the injection of oil into the bladder. Aretæus³ speaks of blistering the scalp in epilepsy; he calls attention to the strangury which cantharides are apt to excite, and recommends milk to be given for several days before the blister is applied. In another place⁴ this author states that cantharides may produce inflammation of the bladder, and bloody urine. Galen follows preceding authors in his history of this insect, but declares, in opposition to them, that all parts of it are alike endowed with medicinal qualities. This statement, as was seen above, is not literally correct. Celsus⁵ says: "If any person have drunk cantharides, he ought to take panaces bruised with milk, or galbanum with the addition of wine, or milk by itself." Matthiolus, in commenting on the above description of Dioscorides, refers to a statement made by later authors, that sometimes the genital organs become violently inflamed by the use of this agent. But neither he nor any ancient writer alludes to sexual excitement as an effect of large doses of cantharides; a fact which may perhaps be explained by the comparatively feeble action of the insects they employed (*mylabris*). The later Greek and the Arabian schools continued to employ cantharides in the same cases as those in which the writers already cited had recommended them, or, at least, in very similar ones, and both internally and externally. The former use of the medicine seems, however, to have grown obsolete, and indeed to have fallen into such discredit that, in 1698, the London College of Physicians caused one of its fellows to be imprisoned for having prescribed it internally.⁶ This person, named

¹ Hist. Nat., xxix. 30.² Op. cit., vi. 1.³ De Morb. Diut., i. 4.⁴ De Causis et Sig., x.⁵ Book v. ch. 27.⁶ A certain Capivaccius, in the 15th century, maintained that cantharides might be successfully given in dropsy and suppression of urine.—Vid. CAMPET, *Maladies Graves*, &c., p. 175.

Groenvelt (Angl. Greenfield), was a native of Holland, and a distinguished lithotomist. He composed a work in which the powers of cantharides are exalted as a remedy for various affections of the urinary passages, and for vesical catarrh in particular. He also vaunts the power of camphor, when associated with it, to correct its acrimonious qualities and prevent strangury, both when given internally and when mixed with blistering ointment. It may be remarked that this physician was in the habit of giving much larger doses of camphor for this purpose than it is usual to prescribe, as much, even, as from ten to twenty grains at a dose.¹

The use of cantharides for vesication was rendered general by the Arabians, who used them particularly in soporose affections, for poisoned wounds, and to relieve deafness. After the revival of learning, Fernel was one of the first to employ the revulsive powers of fly-blisters to cerebral affections, and Houllier extended their use to obstinate affections of the skin, to neuralgia, and gout. During the greater part of the sixteenth century these agents were used with suspicion and great reserve by Ettmüller and Sennert; but when the plague ravaged Italy in 1575, Mercurialis employed them with remarkable success. Although the method had been extensively adopted, it was nevertheless strenuously opposed by certain Galenists, and a dispute ensued, in which Saxonia advocated the use of blisters, and so thoroughly defended his thesis as to have it said of him that "writers since his time plainly follow him, and have hardly added anything upon the subject."² Among subsequent writers, Hoffmann is the one who has furnished the most complete account of the uses of vesication by cantharides.³

ACTION. *On Animals.*—The first experimenter upon this subject appears to have been Baglivi.⁴ By injecting tincture of cantharides into the jugular vein of a dog, he produced great debility and suffering, with inordinate thirst, and death, preceded by signs of great pain and by convulsions. He found in the blood a number of little drops like oil. Hillefeld⁵ gave to a dog a drachm of powdered cantharides mixed with water. An hour afterwards there were signs of great debility, but no anxiety, and at the end of four hours the animal moaned and howled continually, and passed urine and bloody feces. He gradually grew weaker, and at last died in about twenty hours from the commencement of the experiment. No marks of inflamma-

¹ A Treatise on the Safe Internal Use of Cantharides. Written in Latin by Dr. J. Greenfield, and translated by J. Marten. London, 1705.

² FREIND, On Fevers, p. 134.

³ Op. Omn., vi. 67.

⁴ Pract. Phys., p. 412.

⁵ WIBMER, Wirkung, &c., iii. 253.

tion were found in the bladder, except a few red points, but the intestinal canal was inflamed throughout, and in some places resembled a piece of scarlet cloth. Schubarth¹ produced almost exactly the same symptoms with a similar dose of the poison. The dog on which he experimented grew feeble and tremulous, and vomited, and his pulse became smaller and more frequent. The urine was scanty, and passed with difficulty, but was not high-colored. The intestinal canal and the urinary passages were found greatly injected after death. Smaller doses were given to other dogs, and produced a frequent desire to urinate, signs of salaciousness, and, in a bitch, an irritation of the sexual organs, shown by her rubbing them constantly upon the ground. The numerous original and collected experiments described in Orfila's treatise concur in showing almost identical results with those already cited, and need not, therefore, be detailed. In nearly all of them it may be remarked, however, that there was very little evidence of inflammation or of functional excitement about the genital organs. The absence of these symptoms, and especially of the former, which in the human subject occurs so frequently when poisonous doses of the substance are administered, adds another to the many motives already existing for a habit of caution in reasoning from the results of experiments in the lower animals to the action of medicines upon man. The experiments of Orfila and of Beaupoil led to conclusions of which the following is a summary.² In doses of from thirty to sixty grains, powdered cantharides almost always are fatal to dogs of a medium size. The ingestion of the powder is nearly always followed by vomiting, with horripilations, some convulsive movements, and a restlessness indicative of severe pain. These symptoms are succeeded by coldness, depression, and death. On examination of the stomach and intestines, they are found uniformly, and the kidneys and bladder occasionally, to display signs of inflammation. When the powdered flies are applied to a wound, they excite great pain and inflammation, vomiting, depression, laborious breathing, &c., and ultimately destroy life. The experiments of M. Dieu³ furnished results almost identical with those now described. In addition, he observed that if the powdered flies, mixed simply with water, were administered to dogs in doses of from thirty to fifty grains, a copious discharge of urine and fæces took place, and the action of the heart was strikingly reduced. When the medicine was exhibited along with distilled water of cherry laurel, the combined dose proved rapidly fatal, although each ingre-

¹ WILMER, *Wirkung*, &c., iii. 262. ² *Dict. de Méd. en xv. vol.* ³ *Mat. Méd.*, ii. 24.

dient by itself was incapable of producing this result. Forty-five grains of camphor, mixed with thirty of cantharides, were fatal to dogs by producing a remarkable degree of depression and debility; but it was necessary to employ a draehm and a half of the former alone, and of the latter a much larger dose than the one stated, in order to produce a similar result. Alcohol, on the contrary, suspended, and finally overcame, the effects of the cantharides, just as the Italian experimenters found it to do in the human subject. The conclusion which these observers drew from their experiments, that the action of cantharides is essentially sedative, deserves attention. Not, however, that they prove this thesis; but they go far to demonstrate that the excitement which usually follows the application of blisters, and the internal use of cantharides, is due to the diffused and reflected influence of the local inflammation, and that the general depression which follows is due as well to a direct action of the medicine as to the reaction from the local irritation of the medicine upon the internal organs, as well as upon the skin.

The action of *cantharidin* on animals has been tested by several experimenters. According to Orfila, fifteen grains introduced into the cellular tissue of a dog's leg destroyed the animal in three hours. The symptoms were like those produced by Spanish flies, but more severe. In Pullino's experiments, half a grain of cantharidin dissolved in milk and administered to a dog produced general loss of power, immobility, and death within half an hour. One and a half grains dissolved in fifteen drops of double-distilled laurel water destroyed a large rabbit almost instantaneously, although the same animal had, several days before, taken twenty drops of the laurel water without serious inconvenience. Two grains were inclosed in dough and administered to a small rabbit. The animal fell down insensible; the limbs were paralyzed, and the temperature of the body declined. Death occurred within three hours.

On Man.—Internally. The action of cantharides when swallowed is that of an acrid irritant. Besides the disagreeable taste already alluded to, if the quantity taken be large a burning heat is felt in the mouth, fauces, œsophagus, and abdomen; there is sometimesptyalism, together with constriction of the throat, and a difficulty of swallowing so great that the attempt to drink excites violent spasms. Usually there is nausea and vomiting often of bloody matters; unnatural, fibrinous, and sometimes bloody stools, griping, meteorism, and extreme tenderness of the abdomen.¹ These symptoms of intestinal

¹ WIBMER, *Wirkung*, &c., iii. 264.

inflammation often terminate fatally. When death does not take place rapidly, other symptoms, which depend upon absorption of the active principle, are displayed. There is an incessant desire to urinate, but a small quantity only of high-colored and scalding urine is voided with extreme suffering. The urine is sometimes bloody, and a burning pain is experienced in the region of the bladder and kidneys. The urine under these circumstances is highly albuminous. In some cases the genital organs are at the same time violently excited, the penis is in a state of rigid erection, and occasionally there is satyriasis with seminal emissions.¹ In the female, swelling and heat of the organs of generation have been observed, and during pregnancy abortion is apt to be produced. It has repeatedly happened that the genital organs have been attacked with gangrene, even in cases in which no sexual excitement was manifested. Indeed, venereal excitement is a symptom of rare occurrence even in fatal cases of poisoning by Spanish flies. In twenty-five such, collected by Dieu, although priapism was a constant symptom, sexual desire was very rare.

To the symptoms above detailed, are added those of general excitement, a frequent small pulse, quick breathing, heat of skin, vascular injection of the face and eyes, thirst, pain in the head, delirium, trembling, universal tetanic spasms, and subsequently coma. According to Dieu, the above described symptoms of stimulation, if they do not prove fatal, are followed by striking evidences of sedation. There is a general sense of coolness or a copious and cool perspiration; the patient feels inexpressibly prostrated; his eyes are dull, sunken, and surrounded by a dark circle; the features are expressionless; giddiness, faintness, or complete swooning ensue, and there may be vomiting or diarrhoea. It is evident, however, that such symptoms cannot fairly be ranked with the proper and peculiar effects of cantharides; they are such as follow all violent excitement accompanied with severe pain.

The quantity of cantharides required to destroy life cannot be accurately fixed. The smallest dose known to have this effect, is twenty-four grains taken in two doses; but the patient was a pregnant female,

¹ Cases have occurred in which the erotic madness has reached a frightful degree. Such an one is that related by Cabral of a man who had taken a poison containing two drachms of cantharides to cure him of a quartan ague, "*ce qui le rendit si furieux à l'acte vénérien que sa femme nous jura son Dieu qu'il l'avoit chevauchée dans deux nuits quatre-vingt et sept fois sans y comprendre plus de dix qu'il s'estoit corrompu ; et mesmes, dans le temps que nous consultasmes le pauvre homme spermatisa trois fois à notre présence, embrassant le pied du lit, et agitant contre iceluy, comme si c'eust esté sa femme.*"

and abortion was produced. An ounce of the tincture has destroyed life, but only after the lapse of a fortnight.¹

The effects of *cantharidin* do not include so many symptoms of direct irritation as those above described. A pupil of Giacomini took five-eighths of a grain of this substance. Soon afterwards, the pulse had fallen from 63 to 57; there was a desire to urinate, with pain in the tract of the urinary organs. General *malaise* followed, with some confusion of the mind, prostration, faintness, a sunken and dull countenance, cold sweats, vomiting, suppression of urine, and a pulse of 45. A glass of wine revived the strength partially, yet only for a short time; an hour and a half later the symptoms reappeared, and the pulse fell to 30. Feeling greatly alarmed, Giacomini administered rum in small quantities until half a pint of it had been taken. Under its influence the symptoms gradually improved, but no sign of alcoholic intoxication followed. Several days elapsed before the experimenter regained his appetite. Pullino,² who took four grains in doses of one grain each, and at short intervals, experienced symptoms almost identical with the above, but much less severe. He also found relief in a glass of brandy, to which he added ammonia.

Externally. When cantharides are applied in an ointment to the skin, there is produced, after the lapse of one or more hours, some degree of redness, a feeling of numbness in the part, and afterwards a stinging and burning pain, which is not, however, apt to be severe unless it is aggravated by the contact of external objects with the inflamed skin. After the lapse of some time, varying with the natural delicacy of the skin and its degree of previous irritation, a number of vesicles arise which subsequently coalesce so as to form bullæ, or it may be a single large cavity containing serum. This fluid is of a pale yellow color and faint taste and smell, is alkaline in its reaction, and consists chiefly of water holding in solution some albumen and an animal matter with a small proportion of salts. The adjacent cutis is seldom discolored. On removing the epidermis, and allowing the fluid to escape, the chorion is found to be of a pale red color, and its papillæ are rather prominent. The serum which bathes it, gradually thickens and dries, and forms a slight pellicle, which on exfoliating, leaves the skin sound beneath. If the action of the blister is more energetic, the chorion becomes inflamed, and is coated with a fibrinous layer which can generally be removed with ease, but is soon formed again, and gradually grows firmer and more adherent. If now allowed to heal, this deposit shrivels, dries, and finally exfoliates, leaving beneath it

¹ Am. Journ. of Med. Sci., i. 368.

² STRUMPF, Handbuch.

a new epidermis, through which the skin looks red and feels delicate to the touch. When a blister is applied to a part furnished with hairs, they fall out, but are reproduced in the course of two or three weeks.

If a blister is of large dimensions, and is permitted to remain until the occurrence of full vesication, strangury and the other constitutional effects of cantharides sometimes ensue, such as pains in the loins, colic, thirst, micturition, ardor urinæ, hæmaturia, &c. Cases of death from the operation of a blister are recorded.¹ When applied near the origin or over the course of lymphatic vessels, the corresponding glands are apt to become swollen and inflame, and may even suppurate. The action of the absorbed cantharides is further shown by a pellicle which generally covers the urine during full vesication of the skin, and which is sometimes quite thick. If the blister remains long applied, it may, as already mentioned, occasion profuse suppuration, erythematous or crysipelatous swelling, unhealthy granulations, and even gangrene. It may also give rise to an eczematous or eethymatous eruption in the neighborhood, which has been known to spread itself over the whole body. In some cases anthrax has been developed under the application of a blister, but, perhaps, only during an epidemic tendency to that form of disease. It must not be omitted to mention that blisters occasionally seem to have a poisonous action, producing a high degree of fever and nervous excitement. But the precautions recommended to be taken in their use, in the present article, are sufficient, it is believed, to obviate all unpleasant consequences.

Cantharidin is singularly rapid in its action when applied to the skin. According to Robiquet, one-hundredth part of a grain produced vesication in a quarter of an hour when it was rubbed upon the lip. Paper saturated with a solution of this substance in oil, produces vesication in about six hours. The ethereal solution also vesicates very rapidly, as well as that prepared with collodion, &c.

After death, from the poisonous action of cantharides, congestion of the brain and a serous effusion on its surface are generally found. Sometimes the peritoncum is inflamed, and the stomach, intestinal canal, kidneys, bladder, ureters, and urethra are generally so. The intestinal mucous membrane is readily separable from its connections, is often stained with blood, and sometimes gangrenous.

REMEDIAL EMPLOYMENT. *Internally*.—The internal use of cantharides is indeed far less general and is also less important than the external, but it is apt to be too much overlooked by practitioners.

¹ GUIBOURT, Abeille Méd., xv. 153.

Among the conditions laid down as appropriate for their use, are torpor and atony of the system and an excessive mucous secretion from the bowels. These indications exist in *typhoid fever*, for which disease the tincture of cantharides has been recommended in conjunction with wine whey and other stimulants. It is probable that all of the good of this combination, without any of its evils, would be accomplished by the vinous stimulant alone.

A certain number of cases of *dropsy* cured by the internal administration of cantharides are recorded, by the earlier writers especially. But the method does not seem to have commanded general confidence, and the vouchers for its efficacy are not, with few exceptions, authoritative names. Richter would restrict it to those cases which are distinguished by a torpid state of the system. Ferriar¹ refers to several cases of general dropsy occurring for the most part after scarlet fever, in which the medicine, associated with cinchona, effected a cure. Blackall² mentions that the powder of cantharides in doses of from one-quarter of a grain to one or two grains had been recommended by Lieutaud, and is asserted by him to form the basis of an active empirical remedy for dropsical affections.

Many writers recommend the internal use of cantharides in *chronic bronchial affections*, under very nearly the circumstances in which balsamic medicines are useful, but they are inferior to these latter, and, indeed, of doubtful utility altogether. Even in acute inflammatory diseases of the lungs, the followers of the Italian contro-stimulant school have administered cantharides internally, and, as they declare, with the happiest effects.³ But these statements need confirmation.

The success of tincture of cantharides in the treatment of *chronic eczema*, particularly in females, is characterized by Cazenave as surprising.⁴ He directed at first three, and afterwards five drops every morning in some demulcent drink, and every week increased the dose by five drops. Wilson advises the medicine to be exhibited along with equal parts of compound tincture of camphor, and tincture of cinchona.

Psoriasis, that has returned without assignable cause, and affects persons of an indolent constitution, and also occupies a large surface and has resisted the influence of purgatives, sometimes yields with singular rapidity to the tincture of cantharides.⁵ The patient should be restricted to a very methodical diet. Cazenave states that he has seen a patient who, after suffering for eighteen years from this disease, was cured in a month by the remedy under notice. The same

¹ Med. Histories, p. 206.

² On Dropsies, p. 180.

³ MENDINI, Annales de Thérap., vi. 15. ⁴ Mal. de la Peau, p. 95. ⁵ Ibid., p. 313.

author recommends it also for Grecian elephantiasis. Rayer is of opinion that no other remedy possesses so remarkable an influence over psoriasis, but he objects to it on the ground of its liability to produce strangury, particularly in females, and to derange the digestive function. Of the same affection, Mead had long before said, "I am convinced from experience that there is not a better medicine known against this filthy disease than tincture of cantharides."¹

The older writers furnish numerous examples of the usefulness of cantharides in *chronic affections of the urinary passages* in which the secretion or the discharge of urine is impeded. The work of Greenfield contains many of these which would probably now be described as instances of chronic pyelitis and vesical catarrh. Although modern experience does not in general countenance this use of this remedy, there seems to be no reason why it should not be applicable under the same conditions in which terebinthinate preparations are now employed. Debility or *paralysis of the bladder* has been successfully treated by the internal administration of cantharides, as well as by blisters applied to the sacrum. The former method has also been employed to relieve *incontinence of urine*, as well as *retention* of urine, arising from paralysis of the bladder. The nocturnal incontinence to which children are subject is also stated to be amenable to this remedy. An interesting case occurred to Pereira; it was that of a boy fourteen years old who had been subject to incontinence of urine from infancy. By means of gradually increased doses of the tincture of cantharides he was entirely relieved of the incontinence by day, but the nocturnal discharge continued. The *dysury* of old men, which very generally depends, in part at least, upon debility of bladder, may to that extent be relieved by the medicine under notice, but the danger of its aggravating the inflammatory condition of the lining membrane of the affected organ must not be overlooked. Lisfranc cured a case of vesical paralysis by introducing tincture of cantharides into the bladder by means of a catheter. One drop dissolved in lukewarm water was at first injected twice a day and for several successive days, each dose being increased by one drop.² Some cases of *diabetes insipidus* appear to have been cured by this medicine.

Writers are not wanting who report having cured *gonorrhœa* by means of cantharides. Bartholin employed a vinous preparation for this purpose, and the same practice was extolled by Werlhoff, Mead, and Robertson. Yet the method has never obtained general acceptance. Chronic or subacute gleet discharges have undoubtedly been

¹ Med. Works, p. 455.

² Lancet, May, 1843.

arrested by cantharides given in appropriate doses, but the method has less to recommend it than others in common use. Percira, however, states that he found equal parts of the muriated tincture of iron and tincture of cantharides a successful combination in gonorrhœa of long standing. Doubtless by thus substituting an artificial and temporary stimulation for a morbid and permanent one, the latter may be dissipated. In fact, nearly all of the direct and active remedies for gonorrhœa may be presumed to operate in this manner.

Burdach, after the example of Adair, recommends the internal use of the tincture of cantharides and of aloes for *amenorrhœa*.¹ The cases in which it seems to be most useful are those in which the suppression of the catamenia is connected with a leucorrhœal discharge. J. Murray states that it has been employed as a stimulant in amenorrhœa. The late Prof. Chapman in a note to Burn's Obstetrics remarked as follows: "In suppression of the menses evidently connected with atony of the uterus I have had some success with the tincture of cantharides. I give it in a dose of ten drops morning, noon, and night, gradually increasing the quantity till it amounts to two drachms in the day. The most obvious effects of this medicine which I have observed are an increase in the force of the pulse and a very copious flow of urine." In 1819, Dr. J. Klapp, of Philadelphia, published² a series of cases, nineteen in number, which demonstrated the power of cantharides to restore the suspended catamenia. He found the medicine most useful in cases of torpor of the system, or where excessive action had previously been reduced by depletion, and he attributed its curative effects to the irritation which it occasions in the bladder and rectum and through them in the adjacent pelvic viscera. He directed the medicine in doses at first of fifteen drops three times a day, and gradually increased the quantity to 30 or 40 drops at each dose.

When the *sexual propensity is feeble*, or quite suspended, particularly as a result of long-continued and passive seminal emissions, the cautious use of cantharides has sometimes succeeded in curing the infirmity. Yet the practice is not without danger, for it is ascertained that the males of several species of quadrupeds become diseased when cantharides are administered to them for the purpose of stimulating the sexual powers.³

A large number of authorities assert the power of cantharides to cure *hydrophobia*, and their assertions have been undeservedly discredited by those who supposed the disease just named to be always identical with rabies canina. Hydrophobia is, indeed, an almost con-

¹ System der Arzneim., iii. 107.

² Am. Med. Recorder, ii. 37.

³ MÉRAT and DE LENS, op. cit., iv. 312.

stant symptom of rabies, but it is not uniformly so. It occurs quite as frequently in various hysterical, nervous, febrile, and organic affections.¹ The recorded cures of this affection by cantharides do not throw much light upon the nature of those forms of disease to which the remedy is applicable. The greater number of writers, who, like Wichmann and Rust, have vaunted the anti-hydrophobic powers of cantharides, found their favorable opinion, so far as canine hydrophobia is concerned, upon the prophylactic virtues of the medicine. So fallacious a test in the present case is unworthy of serious consideration.

Externally.—The indications for the use of blisters are very numerous if regard be had to the great number of morbid conditions which they are adapted to cure, but the following enumeration includes, perhaps, all of the important cases. Fly blisters may be employed—1st. To stimulate the system generally; 2d. To promote the absorption and prevent the accumulation of certain morbid deposits; 3d. To recall suppressed discharges; 4th. To promote a favorable issue of internal disease by an external counter-irritation or discharge. Cantharides have been used in conjunction with *rubefacients* in order to heighten the effect of these latter; with soap liniment, or oil of turpentine, for example. But, except as a very local stimulant, they are much less to be recommended than many other agents. The ointment has been employed to excite *suppuration* in wounds supposed to be poisoned. The powder has also been used for *toothache* by being introduced into a carious cavity. The ointment is frequently prescribed in a diluted state as a dressing for blisters, to promote their suppuration, and also to stimulate and promote the healing of indolent *ulcers* and especially of *fistulae* and other sinuses. “Dupuytren’s” ointment for *alopecia* contained tincture of cantharides associated with acetate of lead and Peruvian balsam. Other formulæ of the same character have been recommended by various writers on cutaneous diseases.

Hemorrhage. A blister to the back of the neck is sometimes serviceable in *epistaxis*, and one between the shoulders, when *hæmoptoe* becomes alarming from the quantity of blood discharged. In *apoplexy*, after the use of general and local depletion has relieved the brain from pressure, a blister to the nape of the neck is of the highest utility by completing the restoration of the patient’s senses, if they still remain obscured, and by promoting the absorption of the effused fluid. In all cases of *congestion of the brain*, whether arising from a plethoric state of the system or from the use of narcotics, or in the course of any disease, blisters can scarcely be dispensed with.

¹ RUSK’S Essays, ii. 193.

Dropsy. In general dropsy, blisters applied to the lower extremities have sometimes evacuated the whole effusion. But the method is a hazardous one on account of the danger of producing gangrene. In dropsy of the brain, the application of a large blister to the shaven scalp has not unfrequently caused at least a temporary relief. Some allege it to have effected cures, but the evidence in favor of this assertion is not satisfactory. Johnson cured hydrocele by means of blisters applied to the scrotum.¹

Fevers. The usefulness of blisters in some among this class of diseases is second to that of no other remedy. The most eminent and experienced writers concur very nearly in their opinions upon the subject, and daily observation confirms their soundness. In continued fevers with a tendency to sopor or delirium, says Freind, more persons have been cured by blisters than by any other method of cure, "nay, one may solemnly aver that more people have been recovered by them than by all the rest."² A statement of Baglivi is very much to the same effect. In fevers, he remarks, accompanied with a very low pulse, cold extremities, anxiety, and tendency to coma, "it is incredible what benefit is reaped from blisters." Cullen³ says, that they may be employed at any stage of continued fever, but that they are most beneficial in its advanced stage, when the reaction is weaker and their stimulant effects can do no harm. Hence, according to this author, the place of their application is indifferent except when a topical inflammation or congestion exists, in which case he admits that the blister should be as near to the seat of the affection as possible. According to Percival,⁴ blisters are indicated in low nervous fevers, when the spirits sink, when the contractions of the heart grow languid, and the patient struggles under anxiety, restlessness, delirium, difficulty of breathing and oppression about the præcordia. But in the malignant fevers for which Riverius and Ettmüller extolled them, he thinks that their use demands great caution on account of the dissolved state of the fluids. It was, however, in these very fevers that other writers besides those mentioned eulogized blisters. The appearance of petechiæ constitute the main indication for their use according to Monro, and Pringle directed them for the double purpose of relieving the brain and stimulating the general system.⁵ The precepts of the late Dr. Graves are the fruit of a large experience and a sound judgment, and they conform very closely to those just referred to. According to Dr. Graves, blisters have an important office in typhus (*t. petechialis*) as

¹ Edinb. Med. and Surg. Journ., x. 21.

² On Fevers, p. 141. ³ Works, i. 634.

⁴ Essays, i. 130.

⁵ Diseases of the Army, p. 275.

stimulants.¹ To fulfil it they should be used as *flying* blisters, that is to say, they should be applied for only two or three hours in the same place, and moved from one part of the body to another. Their usefulness when thus employed is very great if the powers of life are much depressed, the action of the heart feeble, the pulse weak, the respiration short and imperfectly performed, and there is a tendency to faintness and sinking. In these cases vesication ought to be so slight that the skin shall seem to be covered with a miliary eruption. But in continued fevers the evacuant action is also important, as well as the sedative influence which depends in part upon the former through the quantity of serum lost, upon the depression which always follows excitement, and to some extent, it may be, upon the depressing agency of the absorbed principle of the cantharides themselves. In the former case the primary and more transient operation of the remedy is sought, but in the latter its secondary and remote influence. To obtain the latter effect blisters must vesicate freely. The proper conjuncture for employing them for this end is very distinctly described by Graves, as follows: "When you find a patient in fever lying constantly awake, or when, on the contrary, you find him continually slumbering, when there is a certain quickness of manner and irritability, and when the cerebral respiration has been noticed for some time without any concurrent debility or pulmonary disease, under such circumstances, you may, in cases of maculated typhus, predict the approach of cerebral symptoms, and the period about which they generally manifest themselves is the eighth, ninth or tenth day. Now in cases of this description your best plan will be to shave and blister the whole scalp." Such extensive blistering is believed not to be necessary. Confined to the nuchæ and occiput, the application is all-sufficient, under the circumstances described.

In the other and principal form of sporadic continued fever (*typhoid*), the utility of blisters is far from being so decided. The most authoritative writers accord to them a very inferior place in the therapeutics of this disease, and some discard them from its plan of treatment altogether. The observations of the writer lead him to a somewhat different opinion. He is persuaded that, when in this disease ataxic symptoms begin to be replaced by those of adynamia, a blister to the nape of the neck will sometimes cut short the downward career of the attack, and further, that, when a tendency to delirium manifests itself early in the disease, a like application will usually arrest the full development of this symptom. Again, when at whatever stage indica-

¹ Clinical Medicine, p. 80, &c.

tions of cerebral effusion occur, no remedy is so powerful to remove them as blistering, especially after local depletion by cups or leeches.

In the sthenic stage of fevers blisters are injurious, and in this opinion all sound authorities are agreed. The expressions of Hoffmann, Baglivi, Alpinus, Pringle, Huxham, Whytt, Percival, Lind, &c., are very emphatic upon this point. Yet from the observations of these writers, and of others, it may be inferred that, although the general rule not to apply blisters during the stage of augmentation in any fever is on the whole sound, yet the local and derivative action may become of such capital importance for the purpose of combating some intercurrent inflammation or congestion, as to overrule the more general precept.

Blisters have sometimes been used as stimulants to favor the development of the eruption in *exanthematous* diseases, or to recall it when it has receded from the surface. They have also been employed to prevent the paroxysm of *intermittent fever* by being applied to the epigastrium two or three hours before the expected attack.

Affections of the Head. In all affections of the head, whether of a congestive or an inflammatory nature, blisters form an essential part of the treatment, whether they act by unloading the cerebral vessels or as a stimulant to the nervous system. In all of those cases where an infusion into or upon the brain or softening of this organ is indicated by the occurrence of convulsions, low delirium, impairment of the faculties or senses, paralysis, &c., the advantages of these remedies are unequivocal. As a general rule, they ought not to be employed during febrile excitement, nor without either general or local blood-letting. In cases of profound stupor, the blister should be applied to the whole of the shaven scalp as well as to the nuchæ.

Ophthalmia. Velpeau at one time recommended the application of blisters to the external surface of the upper eyelid as well as to the adjacent skin in the early stage of this disease. But the method does not appear to have been accepted. More usually these counter-irritants are applied behind the ears, to the nape of the neck, or upon the forehead; sometimes also upon the arm of the affected side.

Inflammations of the Lungs, &c. Graves was, it is believed, one of the first to advise a mode of using blisters which relieves them from the injurious imputations which many writers upon the affections under notice have preferred against them.¹ Nothing, indeed, can be more painful and vexatious to a person suffering under pleuritic or pulmonary inflammation, than a large surface of the chest made

¹ Op. cit., p. 102.

raw and suppurating copiously under a blister applied for twelve or eighteen hours at a time. Such a method might well be suspected of tending to aggravate the internal disease. But the same plaster applied for the space of two, three, or four hours only, and followed by a dressing of simple cerate, gives but little pain, and is far more salutary than deeper vesication. Nor is it at all necessary that the bullæ, unless very large, should be emptied of their serum, and in no case need the cuticle be removed so as to expose the raw cutis, a process which usually gives rise to severe and exhausting pain. As regards pulmonary inflammation occurring independently of idiopathic fever, the utility of blisters is far from being equal in all its forms. When *pleurisy* has passed the acute stage, there can be no doubt of the usefulness of blisters applied to the chest in removing the effused fluid. But the period during which they are useful is a brief one. When once the effusion has become stationary and the acute symptoms have entirely disappeared, blisters are of comparatively little avail. They may, however, be tried before resorting to other methods, and their action should be somewhat prolonged and sustained. *Pneumonia* is, on the whole, less favorably affected by blisters. Rasori and Laennec regarded them as nearly useless; M. Louis has shown that they do not appreciably affect the duration of the disease, and Grisolle has proved very conclusively, in addition, that the symptoms of the pneumonia very seldom subside soon after the full revulsive action of a blister. Rilliet and Barthcz arrived at the same conclusion as regards this disease in children, and Dr. West has been led to abandon the use of blisters entirely. Dr. J. F. Meigs is more disposed to attribute good results to them when judiciously managed, *i. e.*, when they are applied for an hour and a half only, and a mild dressing is employed.¹ Without impugning the conclusions arrived at by nearly all of the cautious and sagacious observers just referred to, it may still be confidently asserted that one of the most distressing symptoms of thoracic inflammation, in its early stage, the stitch in the side, is generally removed at once and permanently by vesication. M. Grisolle, indeed, refers to the continuance of this pain during the convalescence from pneumonia, and to the efficacy of blisters in removing it. It must also be borne in mind that the above named writers, when they condemn blisters in pneumonia, have in view the mode of using them to which they were accustomed, of applying them during many hours at a time so as to produce extensive suppuration. That such a method would be not only useless, but mischievous, is highly probable, apart even from

¹ Diseases of Children, 2d ed., p. 173.

positive evidence of the fact. But the bad effects of this plan form no objection to the appropriate use of the remedy. Nor is it certain that blisters do, under all circumstances, aggravate pulmonary inflammation. Their stimulant effects, which appear to be dreaded by some authors, do not, in the judgment of others, exist when the plaster is of large size, and judiciously employed. Gendrin, for instance, maintains their great utility in the disease before us. But his mode of using them was not the received one among his colleagues. He was in the habit of prescribing very large blisters (6 or 8 inches square) to the chest, and generally with a favorable effect. But such blisters must not be allowed to suppurate; their wholesome action, both revulsive and depletory, ceases within a few hours, and hence they should be healed as rapidly as possible with raw cotton or a dressing of lead cerate. M. Gendrin regards this method as to a considerable extent a substitute for blood-letting.¹ The observations of the writer, who has been accustomed to vesicate after the fashion here described, lead him to the conviction that blisters do exert a favorable influence on the course of thoracic inflammation in robust subjects, allaying the cough and pain, lessening the expectoration, and reducing the force and frequency of the pulse. The most appropriate time for blistering is when the first is passing into the second stage of pneumonia. At this period the stimulant influence of the remedy is important for reviving the strength of the patient, and aiding the use of internal stimulant diaphoretics which are appropriate to the same condition. Some persons have preferred applying blisters upon the front of the chest even when the posterior portion of the lungs is inflamed, because in this situation they are said to be less painful. The reason is not conclusive. With appropriate dressings, a blister upon the back or side is not more painful than one upon the front of the chest. It is, perhaps, even less so, for the movements of the latter part in breathing and coughing are by much the most extensive.

The *stitch in the side* which is so frequently a symptom of pulmonary consumption, and which is sometimes pleuritic and sometimes neuralgic in its character, is very generally removable by the application of a small flying blister over the seat of the pain. In *chronic bronchitis*, either in its simple form or complicated with pulmonary emphysema, large blisters to the chest afford decided relief, as well by diminishing the expectoration, when this is excessive, as by relieving the dyspnoea which may be present. Blisters, judiciously employed, seem to have some influence in retarding the progress of *pulmonary consumption*,

¹ Bull. de Thérap., xlii. 367.

when a succession of them is applied over the seat of the tubercular deposit, and particularly when this exists at the summit of the lung. The pitch plaster with flies is a common application for the purpose. It may, indeed, be doubted whether this mode of treatment exerts any direct influence on the process of tuberculization, but it very probably controls the slow inflammatory process which is constantly going on around the tubercles, and in that manner retards the progress of the disease. Not impossibly it may also moderate the activity of the tuberculous secretion itself.

Inflammations of the Heart and Bloodvessels. It is objected to the use of blisters in *pericarditis* that they interfere with the physical examination of the heart. The only question should be whether they do good. Of this no doubt can exist. Blisters should therefore be employed so soon as the disease is clearly diagnosticated, and local depletion by cups or leeches has been employed. The mode of using them should be that prescribed for all inflammatory affections in this article. Apart from the proper benefit arising from the blister, the collateral advantage it affords of presenting a surface by which mercurials can be introduced into the system is one not to be slighted.

In *phlegmasia alba dolens*, occurring as a consequence of parturition, blisters have been highly recommended, when applied to the calf of the leg or the ham. *Phlebitis* resulting from venesection was successfully treated by Physick by means of a small plaster of simple cerate spread on linen, over which was applied a blister large enough to cover the whole inflamed part, and extending from the wound in the vein three or four inches in every direction.

Blisters are extremely useful in *chronic fluxes of the bowels*, and even in subacute inflammations of these viscera. But they require judicious management. In the emaciated and exhausted condition which these affections commonly produce the infliction of pain is to be avoided, and hence blisters, when applied, should not be allowed to remain until full vesication is produced. They should, however, be large enough to cover a large portion of the abdomen, if the strength of the patient is not greatly exhausted. If the discharges are very frequent and debilitating, such a counter-irritant application will generally moderate and sometimes arrest them, particularly if, in the absence of fever, gentle stimulants are administered internally.

Diseases of the Skin. From a very early period the method has been pursued of endeavoring to convert chronic into acute affections of the skin, and, by thus modifying their degree of activity, to render them more curable. Hippocrates used cantharides in an ointment, destined for the treatment of indolent ulcers. Celsus combated obsti-

nate papular eruptions by the same means. Galen directed a mixture of cantharides and hellebore for producing suppuration and cure in mentagra, lupus, &c. P. Ægina and Aëtius recommended the same plan, which, in later times, was adopted by Ambrose Paré. Many recent authorities favor the method in lepra, psoriasis, and lupus, and amongst them may be mentioned Rayer, from whom these historical references are borrowed. He would restrict its use to cases in which the eruption is of limited extent, but very obstinate, and he also recommends that the blisters be applied for a short time only—for two or three hours in general—and renewed according to the requirements of the case. Cazenave entirely condemns the use of blisters in the treatment of lepra; but it is presumed that his remark does not apply to the inveterate and local forms of this disease.

Petit, of Lyons, used blisters in *erysipelas*, upon the seat of inflammation, but later surgeons have restricted their application to the sound skin in advance of or around the inflamed part. This was a favorite mode of treatment with the late Dr. Physick. But its results are extremely fallacious; the erysipelatous inflammation is seldom arrested by the blistering.

To stay the progress of *gangrene*, blisters have been regarded as among the most valuable resources of art. Cotunnus¹ states that he once saw the lower extremity of a patient laboring under putrid fever become gangrenous, and that the gangrene extended to every part of the legs except those upon which blisters had been applied. The mortification terminated about a finger's breadth from the vesicated skin. Roemer attributed to them the power of arresting this process, and Physick was in the habit of using them successfully for the same purpose, by vesicating all the sound parts in contact with the gangrenous tissues.² *Indolent ulcers* are sometimes very happily modified by blisters applied upon their surface, and extending somewhat beyond their edges. After the lapse of three, four, or, according to some, twenty-four hours, the part is found to be highly vivified, and to have lost its previously dull and dry aspect. Mild astringent dressings are then applied, and the blister renewed as soon as the inflammation has completely subsided. Permanent blisters are sometimes employed as *issues* to take the place of some long-continued habitual discharge, which has been cured by nature or by art. An hereditary or constitutional tendency to apoplexy, or to any other dangerous consequence of internal congestion, renders this, or some analogous measure, of the first necessity. It should, however, be well known

¹ EBERLE, op. cit., p. 483.

² Eclectic Repert., iii. 511.

that an extremely restricted or wholly vegetable diet will usually supersede the necessity of an exutory.

Blisters are sometimes used in the neighborhood of chronic morbid discharges in order to arrest the latter. Thus, *gleet* of long standing has been successfully treated by small blisters applied to the perineum. Dr. S. Jackson, in 1828, called attention to them as revulsives applied to the saerum in *leucorrhœa*. Dr. Laycock¹ found the cantharides plaster very efficacious in atony or *paralysis of the bladder*, produced by lying long in bed, or by an habitual use of the catheter. For this purpose, the blister should not remain applied longer than two hours. Dr. Jackson, just referred to, published² several cases in which the influence of a blister applied to the saerum was very distinct and efficient in *preventing abortion*.³ The same application affords decided relief in *painful menstruation*. It is less severe and more efficient than sinapisms, which are popularly used for this purpose.

So long as articular *rheumatism* is inflammatory, blisters aggravate its symptoms, but when it has become chronic, they are of great value if properly applied. The error is usually committed of allowing them to vesicate fully, whereas the slightest possible elevation of the cuticle is all that is necessary. A succession of blisters thus managed, will generally remove the pain and stiffness of the joint, unless false ankylosis be completely established. An interesting paper on this subject by M. Solon, may be consulted.⁴ When retrocedent *gout* or rheumatism attacks internal organs, blisters to the trunk and extremities are of capital importance. They are sometimes applied over a joint which has habitually been attacked, to attract thither the disease when it is wandering and irregular.

Diseases of the Nervous System. Counter-irritation in one form, especially of *neuralgia*, that of the sciatic nerve was very anciently employed. The actual cautery was recommended by several Arabian physicians, and by many European of the 16th and 17th centuries. But Cotugno was the first to employ cantharides as a counter-irritant for the cure of neuralgia in the sciatic and cubital nerves.⁵ He applied small blisters upon those points of the limb at which the nerve becomes superficial in its course, points which, as he indeed remarks, the patients themselves indicate as the chief seats of pain. He was led to adopt this treatment as well by his observation of the use of the

¹ Lond. Med. Gaz., March, 1839, p. 899.

² Am. Journ. of Med. Sci., ii. 299.

³ Ibid., v. 547.

⁴ Bull. de Thérap., xxxviii. 385, 534.

⁵ A Treatise on the Nervous Sciatica or Nervous Hip-Gout. London, 1775.

actual cautery, as by an hypothesis which he entertained in regard to the cause of the pain in sciatica. He imagined that it was caused by a certain acrid matter circulating in the nerve, and which he proposed by means of blisters, to draw out at whatever points the nerve approached nearest the skin. Yet he did not, as might have been expected, from his hypothetical views, keep up a discharge from the blistered surface by means of irritating ointments, but employed fresh butter as a dressing, so that it was healed by the ninth day. Then, if necessary, the blister was applied again. His success was so remarkable as to give him a wide and eminent reputation. Mr. Teale was the first to observe tenderness of the dorsal branches of various spinal nerves in many cases of neuralgia, and to find that blisters applied over these branches, even without leeching or cupping, which he generally conjoined, sufficed to remove the pain.¹ It was Valleix, however, who finally demonstrated the applicability of blisters to every form of neuralgia, by determining that for every nerve the seat of spontaneous pain is mainly in the superficial points of the trunk of that nerve, and upon its terminal branches, that these same points are nearly always tender when pressed upon, and that in three-fourths of the cases the most successful plan of cure, and often the only one required, is methodical blistering. He found, however, as Cotugno had previously done, that often while the blister is rising the pain is increased, but that afterwards it declines or ceases altogether. He was hence led to content himself with a milder treatment, and directed blisters of about an inch square to be applied upon all the superficial points of the affected nerve where pain occurred spontaneously, or could be excited by pressure with the end of the finger.² The writer has now for many years employed this method in almost every case of neuralgia which has come under his care in public or private practice. In no single instance has it failed to mitigate the symptoms surprisingly, and in very many it has alone achieved a cure. Sciatica more than other forms of neuralgia, is rebellious to this and to all forms of treatment, yet it is more amenable to methodical blistering, than to any other exclusive method whatever. The writer has been led to modify still further, the plan of Cotugno and Valleix, by reducing the size of the blisters recommended by them, and by abridging the time of their application. In all acute forms of the disease, except sciatica, he has found blisters half an inch in diameter, and allowed to remain applied from one to two hours only, to be

¹ A Treatise on Neuralgic Diseases. London, 1829.

² Traité des Névralgies, &c. Paris, 1841.

amply sufficient for effecting a cure. A mild dressing is followed by a rapid healing of the sore, and in less than a week the application may be renewed if necessary.

Convulsive diseases, especially of late years, have been extensively treated by means of blisters applied to the "centre of excited motion," the spinal marrow. It is unnecessary to enumerate all of the particular forms of disease in which this treatment is appropriate. The most important of them, perhaps, is *tetanus*. In this disease, even when of traumatic origin, blistering on either side of the spinous processes, and throughout the entire length of the spine, is an important, if not an essential, element in the treatment. It is possible, though not certain, that the endermic use of the salts of morphia on the parts thus denuded adds greatly to the efficacy of the vesication. It were perhaps better to introduce the narcotic through the ordinary channel. *Partial spasm*, as of the abdominal muscles, of the stomach, of the fingers in what is called scrivener's spasm, of the respiratory muscles in spasmodic asthma, &c., is often relieved by vesication upon or near the affected part. Vesication is one of the most effectual means of arresting the obstinate *vomiting* which is met with in certain febrile affections and in chronic diseases of the stomach. Alone it often answers the intended purpose, but its efficacy is increased by sprinkling the denuded cutis with a small quantity of a salt of morphia. *Epilepsy* and *puerperal convulsions* are sometimes alleviated by the use of blisters. The various forms of *paralysis* depending upon disease of the brain or spinal marrow are, when the cause is removable, greatly benefited by blisters applied to the nuchæ or along the spine. In that form arising from muscular atrophy, as of the deltoid, nothing excites anew the development of the muscle so certainly as a succession of blisters. Puerperal and other forms of *mania*, which seem to have arisen in consequence of the suppression of a discharge, are sometimes cured by the revulsive use of blisters.

It has been proposed to evacuate *cold abscesses* by vesication instead of puncture, which, it is well known, may occasion serious results. By applying a blister upon the attenuated skin, the cuticle is removed, the cutis grows thinner, and ultimately allows the fluid beneath it to escape gradually and without the admission of any air. A not dissimilar method has been employed in the case of syphilitic *buboes*, and, when it succeeds, the unsightly scar left by an incision is avoided. Previously to suppuration, these swellings may very generally be arrested in their progress by judicious vesication. For this purpose a blister must not be allowed to remain applied more than two or three hours, and should be renewed as soon as the skin

has healed. According to some authorities the method is inapplicable to true syphilitic buboes, and successful in those only which are sympathetic. But since the specific or non-specific character of the inguinal swelling is merely conjectural, so long as it does not form and discharge pus, the attempt to institute an abortive treatment ought always to be made. It is unquestionably successful in a great many cases, when care is taken to make the vesication superficial. It just as certainly hastens the suppurative process when the blister is allowed to remain long applied. *Scrofulous* and other indurated glandular swellings are often discussed by the steady and moderate use of blisters.

ADMINISTRATION.—The *tincture* of cantharides is the only preparation which is administered internally, and of this the dose is from twenty drops to a fluidrachm two or three times a day, largely diluted by some demulcent drink. To produce vesication, several preparations of the Spanish fly have been used, amongst which acetum cantharidis may be mentioned. But for nearly all useful purposes ceratum cantharidis and the preparations of cantharidin suffice.

The benefits to be derived from blistering depend so entirely upon its management, that a full description of it may be useful in this place. The place of application for a blister should generally be near the seat of disease, directly over it when this is deep seated, and in the neighborhood when it is more superficial. This precept refers to the revulsive action of blisters. Whenever they are employed as general stimulants, the place of their application is indifferent, provided that it be upon the more delicate parts of the skin, as the inside of the thighs or arms, &c. Many of the older writers direct blisters to be applied for an inordinately long period. One of them (Withers) says "it will generally suffice if the plaster remain upon the part twelve or sixteen hours," but some practitioners, he subjoins, direct them to remain applied thirty or forty hours. Even Pereira gives twelve hours as the usual time requisite for blistering. The late Dr. Graves severely reprobated this custom, which prevailed almost universally so short a time as twenty years ago, and which is still very generally followed upon the continent of Europe. Dr. G. was one of the first among his countrymen to assail the barbarous practice, and to show that four or five hours' application in the adult is sufficient for obtaining all the benefits of blisters in acute diseases, unless the head be the part to which they are applied; in that case they require at least twelve hours to produce their full effect. Still earlier than Dr. Graves, Dr. W. Channing, of Boston, called attention to this point of treatment.¹ "I

¹ N. Eng. Journ. of Med. and Surg., 1826, xv. 238.

do not," he remarked, "recollect one case in which full vesication has failed to occur where the plaster has been on a sufficient time to produce distinct redness and incipient vesicles." And he observes further: "Full vesication will follow its application, if for a couple of hours only, even where no visible effects had been produced at the time of its removal; and this the more certainly when a warm poultice or simple cerate is used as a dressing." Dr. Channing also refers to a practice employed by Odier, of Geneva, in 1811, and which merits attention. It consisted in treating rheumatism by allowing the plaster to remain upon the affected part for an hour only, even although neither redness nor a blister followed. The same plaster was reapplied several times in the course of a day.

Like friction or rubefaction, a febrile state of the system renders the skin more easily vesicated. Hence, as a general rule, the more frequent the pulse and the higher the temperature of the body, the shorter is the time required for the production of vesication. When the skin is delicate, as in children and females, the excessive irritation of a blister may be prevented by causing the officinal cerate to be diluted with lard, or by interposing a piece of fine tissue paper between the plaster and the skin. A proper regulation of the time during which the application is made will generally, however, render these precautions needless. To prevent strangury the most effectual mode is to observe the precepts now so often repeated concerning the duration of blistering. If it be preferred to use camphor for this purpose the most convenient plan is to moisten the surface of the blister with an ethereal solution of camphor. The ether evaporates rapidly, and leaves a delicate film of camphor spread uniformly over the cerate.

The form of the plaster must depend upon that of the part to which it is to be applied, and be so modified as to come into close contact with the latter. The skin may first be washed with warm water and soap. Simple friction or friction with some stimulating fluid will also render the skin more apt to vesicate. A sinapism applied for a few minutes will have this effect still more decidedly. It is of comparatively little consequence on what substance the plaster is spread. None answers better than stout brown paper. It is usual, and more elegant certainly to employ kid. In either case the blister may be held in its place by strips of adhesive plaster. Or the cerate itself may be spread upon a piece of the latter, leaving a sufficient margin to insure its firm and complete attachment.

A simple and very convenient dressing for blisters consists in applying a layer of finely-carded cotton to the blistered cutis,¹ after having

¹ It was originally recommended by Dr. Merrill, of Natchez.

evacuated the serum by punctures or incisions made in the most dependent part. One side of a layer of cotton wadding with the wool towards the skin answers the purpose very well. If the blister is small, this dressing may be left untouched until the skin beneath it has healed. When of larger dimensions, the necessity is greater for more frequent dressings, particularly if the part be one subjected to friction by the movements of the patient. Patent lint may be used instead of cotton, and is indeed preferable when the affected surface is of large extent. So long as the cuticle remains entire, or nearly so, no other dressing than the foregoing is required, but if the raw and inflamed chorion is exposed, a dressing of simple or of lead cerate is better adapted to allay the inflammation and to promote the healing of the part.¹ When a blister is intended to discharge the office of an exutory, this course must be modified. Not only must the plaster remain applied for a much longer time, but the cuticle must be altogether removed at the first dressing, and simple cerate applied for a few hours, after which the basilicon ointment may be substituted. Under the use of this latter the discharge generally grows purulent. If it be desired still further to prolong the secretion, mezereon or savine ointment may be used. When the vesicated skin becomes uneven, swollen, and discharges a thin and offensive fluid, and at the same time an erysipelatous blush appears around the wound, cooling and slightly astringent poultices or salves should be applied. The best application for the vesicular or pustular eruption which sometimes makes its appearance around the sore, is a fresh and mild mercurial or lead ointment frequently renewed. A dressing composed of one part of red precipitate ointment with fifteen or twenty of simple cerate, is recommended by Trousseau. The common lime-water liniment, or a diluted solution of the subacetate of lead, is more appropriate if there is much inflammation. If the vesicated cutis assumes an indolent aspect and is covered with large and flabby granulations with little or no secretion, local stimulants must be resorted to. Of these the best is nitrate of silver, but other caustic and stimulant applications may also be used.

Trousseau has directed attention to a probable explanation of the fact that in many persons blisters heal with singular rapidity, by referring it to a law established by general observation, viz., that in some persons wounds of all sorts have the same tendency. In children, as a general rule, the tendency of blisters to heal is very remarkable, but the extremely active state of the nutritive function in

¹ A favorite dressing with the people, and among country practitioners, consists of fresh cabbage leaves (*Brassica oleracea*).

early life seems to explain the fact. In old persons, on the other hand, blisters are slow to rise, and their suppuration is scanty and imperfect, while the sore which they leave behind is healed with difficulty. In certain stages of the constitution depending upon individual peculiarities, or upon an epidemic influence, blistered surfaces have a tendency to be covered with false membranes. This is peculiarly the case in croup (pseudo-membranous laryngitis), and during the prevalence of dysenteric affections, particularly in large hospitals. Some persons have indeed regarded the inflammation produced by cantharides as of an essentially diphtheritic nature. Bretonneau demonstrated that an ethereal preparation of cantharides injected into the trachea, or placed upon the lips of dogs, produced an inflammation remarkably like that of croup. But such effects in the human subject are, it is well known, quite exceptional. The false membranes upon blisters are most apt to arise under an epidemic constitution of a typhoid kind. To remove them the most effectual mode is not to use emollient poultices, or to render the dressings less stimulant, but on the contrary, according to Trousseau, when the false membranes grow thicker and more adherent, to apply a blister immediately upon them. These remarks refer to the more perfect membranes; but if the sore become coated with soft, grayish, and pultaceous concretions, exhaling a gangrenous odor, and at the same time bleeds readily, and is surrounded by an erysipelatous blush, mild and emollient dressings are alone appropriate at first, and such as are slightly astringent and stimulant afterwards.

The late Dr. Beck, of New York, called particular attention to the modifications required by infancy and childhood in the application of blisters.¹ In regard to its duration, Dr. B. agrees with Evanson and Maunsell, Neligan, Ballard and Garrod, West, J. F. Meigs, and nearly all recent authorities, that as soon as the skin is uniformly reddened the plaster should be removed and a poultice applied. A neglect of this precaution—a method like that which formerly prevailed, of allowing blisters to remain applied to children for six or eight hours—is prolific in mischievous effects, violent general excitement, convulsions, exhausting pain, and even gangrene and death when the child is feeble, prostrated by prolonged illness, or suffering from an eruptive disease. In the last-mentioned case the tendency to gangrene is very strong; and if in such a one blisters are judged necessary, they should be applied for the shortest possible time sufficient to produce their in-

¹ *Infant Therapeutics*, p. 62.

tended effects. In all cases the dressing should be of the mildest description, and none is better than finely-carded cotton.

Treatment of Poisoning by Cantharides.—When a poisonous dose of these insects has been taken, a vegetable emetic should be promptly administered, and other means employed to evacuate the stomach, after which copious draughts of mucilaginous and albuminous liquids should be given, in order to protect the digestive and genito-urinary organs. General warm baths and warm cataplasms to the abdomen may also be prescribed, and emollient fluids, if necessary, injected into the bladder and rectum. The enemata may contain laudanum.

It seems clear that however serviceable camphor may be in preventing or in mitigating the irritation of the urinary apparatus, it is useless, if not hurtful, when poisoning has actually occurred. The Italian school¹ recommend wine and other alcoholic drinks, and in severe cases the addition of a small proportion of opium. If the reported cases of the efficacy of such means can be relied on, stimulants are certainly to be preferred to sedatives and emollients in the treatment of the constitutional symptoms. They find an appropriate object in sustaining the nervous system, while diluent drinks tend to correct the irritant action of the poison upon the digestive and urinary organs. Oil has also been much used as an antidote. Whether it does more good by sheathing the particles of the poison, or more harm by affording them a solvent, is still undecided.

¹ GIACOMINI, p. 149 ; DIEU, iii. 40.

CLASS IV.

T O N I C S .

THE preceding divisions of the *Materia Medica* include medicines whose predominant characteristic is their action upon the part to which they are directly applied. Those which we now propose to examine are, on the other hand, distinguished rather by their remote effects upon the economy. While the former appear primarily to affect rather the physical relations of the particles which compose the tissues, the operation of the latter is first manifested in a modification of the functions of the organs, often without any discernible influence upon their physical condition. Or, to express this difference theoretically, the one division consists of medicines which affect the tissues themselves, but the other of those which modify the composition of the blood, nutrition, and the action of the nervous system. In this latter are comprised tonics, stimulants, and sedatives.

The word tonic is derived from the Greek *τείνω*, I stretch; and, by a figurative allusion to a stringed musical instrument, the cords of which do not give out their proper sound unless made duly tense, tonic medicines may be described as those which gradually produce the requisite degree of tension of the nervous system, or, generally, of the living fibre, and which enables it fitly to respond to all of its natural and appropriate stimuli. The idea of tension is inseparably associated with all our notions of vital force, because the most common, if not the only, conception we possess of organic power is derived from our experience of the phenomena of muscular force, which is always displayed in connection with the tension of muscular fibre.

All exhibitions of force in the animal economy involve two elements, a vital and an organic element; the former of which represents the power, and the latter the mechanism by which the power operates. The organ may be fully developed and sound, but the power to move it may be defective; or, on the other hand, the vital activity may be

unimpaired, or even exaggerated, but, from defective nutrition, the organ may be unable to manifest the power which is expended in it. Finally, neither of these elements may possess the requisite degree of development; the organ may be imperfectly nourished, and, at the same time, the vital force may be wanting which is required for the performance of its functions.

For these morbid conditions nature has bountifully provided remedies; stimulants to excite and tonics to strengthen, and, as if with an intelligent anticipation of the needs of the system, a third class of medicines which combine the virtues of the other two. Not altogether different in their essential nature, tonics and stimulants do not exclude, but are rather complementary to one another, the former developing the organic nutritive element, the latter the dynamic, nervous, or vital power. According to the necessities of each case of disease, we may employ an exclusively tonic or an exclusively stimulant method of treatment, or combine the two by associating representatives of each class, or prescribing those in which tonic and stimulant virtues are united in different proportions, and which are called tonic stimulants, or stimulant tonics, according to the quality which predominates in each.

Comparing pure tonics and pure stimulants with one another, we are struck with this remarkable difference between them, that while the influence of the latter is transient, that of the former is comparatively permanent. Stimulants, acting upon the nervous system, rob it of power by their very stimulation, and, unless the loss were made up for by an external supply, would soon exhaust it completely; but every tonic operation, under due conditions as regards nutriment, adds to the strength of the system in a slow and gradual, but permanent, manner. Nevertheless, tonics are stimulants of the organic forces, and, as we shall see, produce some of the worst effects of stimulants when employed too lavishly, and not in due proportion to the susceptibility of the stomach and of the nervous system. Stimulants are also virtually tonics when, by means of their power over the intensity of organic operations, they enable the stomach to digest food which, without their aid, would be only burdensome and irritating.

Besides the groups of tonic medicines just mentioned, there is another, which may with propriety be called specific, because each member of it presents peculiarities depending upon its essential nature, or upon its association with an element possessed of specific powers. The most important article of this class is iron. Its operation upon the stomach, and, therefore, its direct influence upon the function of digestion, is almost inappreciable; and those of its preparations which are administered with a view to this effect owe whatever efficacy they

may have in promoting it to the acids with which they are combined. A more correct denomination for iron would be that of a nutrient medicine, for its presence in the blood, and in the solids also, is quite as essential as the elements of ordinary food to the performance of their functions. Cinchona possesses the virtues of a true tonic, and that in a high degree, but its most eminent qualities depend upon quinia and the other alkaloids which it contains, and which impart to it antiperiodic virtues. A similar remark is applicable to willow and dogwood barks, although the specific properties in them are very feeble, and, indeed, according to some, do not exist at all. Finally, wild-cherry bark contains a bitter and tonic principle combined with a direct sedative, hydrocyanic acid, and affords, it is believed, the only example of this association of apparently antagonistic virtues in the same substance.

Bitter tonics, or those vegetable productions which appear to owe their tonic properties to their bitterness, if taken a short time before meals, excite the appetite, and render the debilitated stomach capable of digesting a greater quantity of food than it could otherwise dispose of. Consequently, under their influence, and provided that the secondary assimilation be not impaired, the muscular strength becomes increased, and all the operations of the economy are more vigorously performed.

The nature of the action excited by vegetable bitters upon the stomach is not well understood; but a consideration of their effects under different circumstances renders it probable that they act as irritants. For if they are used in excessive doses they excite gastric uneasiness, pain, and even vomiting, the latter the more readily if they are administered in warm infusion. Under such circumstances, if not rejected by the mouth, they may occasion colic and diarrhœa. It is also well known that if their dose is not proportioned to the susceptibility of the digestive organs, they may not only cease to produce a tonic effect, but absolutely to destroy the appetite and give rise either to diarrhœa or constipation. It is, moreover, a familiar fact that a febrile state of the system altogether contra-indicates their use, because they then immediately derange the stomach and augment the vascular excitement. This is at least true as regards acute febrile diseases. It is even more important in its relation to the present question to bear in mind that when these medicines are administered to persons in full health, they are very far from augmenting the vigor of the system generally or of the organs of digestion. They impair the appetite, derange the functions of the stomach and bowels, coat the tongue, excite headache, and in fact engender the very condition which under different circumstances they are adapted to cure.

It is also to be observed that medicines of various kinds impart activity to the digestive function. Many irritants, it is well known, are used as condiments, and alcoholic stimuli are everywhere employed before and during meals to increase the appetite and promote digestion. Now there is no evidence at all to show that bitter tonics exert any part of their influence after absorption; everything, on the contrary, tends to prove that their action is limited to the mucous membrane of the stomach and bowels. If such be the case, we must look for an explanation of their differences from irritants and from alcohol, chiefly in the peculiarity of the mode and degree of their stimulation. It is evidently gentler than the one, and both gentler and more permanent than either, and hence would seem to be better fitted than either to restore that natural tone to the digestive organs which they have lost through the protracted operation of debilitating causes.

If now we endeavor to learn the cause of this peculiarity in the present class of medicines, and turn as we naturally must to their physical qualities for a solution of the question, we are immediately struck by the quality of bitterness which they possess in common, and are disposed to conclude that in it reside their tonic virtues. Although this conclusion is true, it does not appear to embrace the whole truth. Among pure vegetable tonics the most powerful is quassia, in which the quality of bitterness resides in a most intense degree, yet it is surpassed in this respect by sulphate of quinia, which, however, is inferior to it in purely tonic qualities. A similar remark may be applied to *nux vomica* and its alkaloid *strychnia*, which exceed all other substances in bitterness, but whose tonic virtues, properly so called, have not appeared to us to entitle these medicines to a place in the present class. *Aloes* and *colocynth* are also extremely bitter, but are scarcely to be regarded as tonics. These facts, although few in number, are sufficient to prove that the cause of bitterness is not identical with the tonic quality, although generally associated with it. We must not quit this brief notice of an interesting question without referring to an analogy which probably is not without its significance. The *bile* has a bitter taste, and the importance to digestion of this secretion is very great. It is true that its influence is generally ascribed to its alkaline qualities, and they are doubtless essential to good digestion; but we may not overlook the fact that a bitter secretion is provided by nature to which we may without much risk of error ascribe some share in the activity of intestinal digestion, and hence reasonably infer that the analogous quality in tonic medicines must exert a similar influence upon the function of the stomach.

In regard to the therapeutical applications of tonic medicines, it

may be remarked that those called specific have, as their name imports, an application to special diseases; iron to anæmia, or deficiency in the red globules of the blood, and Peruvian bark and its associated barks to periodical, and especially malarial paroxysmal diseases. These vegetable tonics may be more or less applied to the same cases as simple bitters and stimulant tonics.

As it has already been intimated, iron enters into the system to be assimilated and occupy its place in the blood, muscle, &c., as a constituent of the body, while bitter tonics operate primarily and perhaps exclusively upon the stomach and intestine, increasing the appetite, and promoting assimilation of the food. Hence a practical precept arises, of no small importance, when the digestion is feeble and iron is indicated, always to associate with it one of the bitter vegetable tonics. Thus it is that "bark and iron" have long been looked upon as almost inseparable coadjutors in the tonic regimen.

SPECIFIC TONICS.

FERRUM.—IRON.

DESCRIPTION.—Iron is the most abundant and widely diffused of the metals. It forms a considerable proportion of the solid crust of the earth, and probably also of the heavenly bodies, for meteoric stones have been found to consist of it almost entirely. It enters into the composition of very many if not of all vegetables, and is an essential constituent of the animal organism, where it exists in the blood in the proportion of about one-half a grain in a thousand.

The color and density of iron are too familiar to require description; its ductility is very great. Its sp. gr. is 7.79. It fuses at 2850° F., but at a much lower temperature burns in the air. It is extremely oxidizable in moist air. Heated to whiteness, it decomposes water, and combines with its oxygen. Its combinations are all remarkable for their styptic qualities.

The forms in which iron is prepared for medicinal use are very numerous, and, with some differences arising from the operation of the sulphates, are so nearly analogous in their therapeutical powers, that they may be advantageously treated of under the same general head. Viewed with reference to their composition, they form several

groups which may thus be enumerated: 1. Iron in the metallic state; 2, oxides; 3, combinations with, *a*, mineral acids, and *b*, organic acids; and 4, compounds with halogen bodies.

1. *Preparations of Metallic Iron.*

Ferri Pulvis.—POWDER OF IRON; QUEVENNE'S IRON; IRON BY HYDROGEN.

This preparation, which consists of metallic iron in a finely-divided state, is obtained by reducing the sesquioxide by hydrogen. When this gas is passed over the sesquioxide heated to redness, it abstracts the oxygen of the latter, forming water, which escapes, while metallic iron is left behind. To prevent re-oxidation, it must be carefully protected from the air. Powder of iron is of an iron-gray color, and without taste or smell. When pure, it causes effervescence on being thrown into a dilute acid, because its attraction for oxygen disengages the hydrogen of the water, which escapes.

Ferri Ramenta.—IRON FILINGS.

This ancient and useful preparation of iron may be obtained by filing a piece of pure and soft iron. When, as is often done, it is procured by beating in an iron mortar, and sifting, the refuse of workshops where iron is manufactured, it is very apt to contain portions of copper, and also to be partially oxidized.

2. *Compounds of Iron with Oxygen, and their Preparations.*

Squama Ferri.—SCALES OF IRON; ETHIOPS MARTIALIS.

This preparation, which is composed of variable proportions of the sesquioxide and protoxide, was formerly obtained by washing the scales which fall from heated iron when it is hammered on the anvil. It was subsequently prepared by allowing iron filings to remain for a long time under water, and then washing from them the adherent particles of oxide and sesquioxide of the metal. As thus prepared, the mixed oxides form a fine powder, of a velvety black color and metallic lustre. It readily attracts moisture from the air, and its color then changes to a dirty green. A similar admixture of the two oxides, combined with water, was obtained by Preuss and Wöhler by means of a speedier method than the above. To a solution of sulphate of iron in hot water, nitric acid is added until the nitrous vapors cease to be given off, and the liquid becomes brownish red on the addition of ferrocyanate of potassa. With this, a solution of sulphate of iron like the first is mixed, and on the addition of caustic ammonia the two oxides of iron combined with water are thrown down.

Ferri Oxidum Magneticum.—MAGNETIC OXIDE OF IRON. D.

This preparation results from the action of caustic potassa upon a

solution of the sulphate and the persulphate of iron, and is a compound of the protoxide and the sesquioxide of iron. It is a grayish black powder of velvety smoothness, without taste or smell, and is strongly magnetic. It does not change by exposure to the air at ordinary temperatures. It dissolves in the stronger acids without effervescence.

Ferri Oxidum Hydratum.—HYDRATED SESQUIOXIDE OF IRON.

By the addition of sulphuric and then of nitric acid to a solution of sulphate of iron in water a tersulphate of the sesquioxide is formed, which is then decomposed by the addition of ammonia, and the sesquioxide is precipitated. It is directed (Ed. Phar.) to be kept in two states, with water, in close bottles, as an antidote for arsenic, and dried for use as a medicine. In the former state it is a reddish brown gelatinous or pulpy semi-solid, and in the latter a magma or powder of the same color, and without either taste or smell. If the moist preparation be mixed with arsenious acid in solution in the proportion of twelve parts to one of the acid, a very insoluble arsenite of protoxide of iron is formed.

Rubigo Ferri.—RUST OF IRON.

This familiar substance results from the action of air and water upon iron, and is usually described as a sesquioxide of iron, with water. It is supposed also to contain a variable proportion of the carbonate of iron and of the carbonate of ammonia. Of a light yellowish brown color, without much taste or smell, it was formerly in common use as a chalybeate, but it is now supplanted by the so-called precipitated carbonate.

Ferri Subcarbonas.—SUBCARBONATE OF IRON; PRECIPITATED CARBONATE; SESQUIOXIDE OF IRON.

This preparation, which is a hydrated sesquioxide and not a carbonate of iron, contains, however, a small proportion of the latter compound. It is obtained by precipitation from a solution of the sulphate of the protoxide of iron by means of carbonate of soda, and afterwards washing and drying the precipitate. By exposure to the air it is rapidly converted into the sesquioxide. It is of a bright reddish brown color, and is without smell, but has a somewhat ferruginous and styptic taste. It generally effervesces with acids.

Pilulæ Ferri Carbonatis.—PILLS OF CARBONATE OF IRON; VALLET'S FERRUGINOUS PILLS.

In order to prevent the conversion of the protoxide of iron into the sesquioxide, noticed in the preceding paragraph, Beeker of Mulhausen, in 1835, proposed the method about to be described; it was subsequently modified by Vallet, who gave his name to the pills which have now become official. The method consists essentially in taking advantage of the power of sugar to prevent oxidation, and by its

means protecting the iron in each step of the process above described for procuring the protoxide. The solutions employed are sweetened with sugar, and the precipitate, having been allowed to drain, is mixed with honey and sugar and evaporated to a proper consistence for making pills. These contain about half their weight of carbonate of iron. The mass is black, and has a sweet and at the same time ferruginous taste.

Mistura Ferri Composita.—COMPOUND MIXTURE OF IRON; GRIFFITH'S ANTIHECTIC MIXTURE.

This mixture contains myrrh, carbonate of potassa, sulphate of iron, spirit of lavender, sugar, and rose-water, but its efficacy is chiefly due to the iron, which it holds in the form first of the carbonate of the protoxide and afterwards of the sesquioxide. This conversion, which is due to the action of the air, is marked by a change of color in the liquid from green to brown.

Pilulæ Ferri Compositæ.—COMPOUND PILLS OF IRON.

These pills contain the same active ingredients as the compound mixture of iron, viz., myrrh, carbonate of soda, and sulphate of iron. By their trituration with syrup a carbonate of the protoxide, which speedily changes to a carbonate of the sesquioxide, is formed.

Natural Mineral Waters.

Chalybeate springs are extremely numerous. This might indeed be expected from the great abundance of iron in the earth. They may readily be recognized by the rusty deposit upon the stones and the soil which they cover, the iridescent scum that frequently floats upon their pools, and by their ferruginous taste. In these springs iron is generally met with as a bicarbonate or as a sesquioxide, and in a small proportion of instances as a sulphate. It is indeed mainly due to the action of carbonic acid contained in the waters of chalybeate springs that they hold in solution so large a quantity of iron and deposit it as this gas escapes. To the abundant impregnation of many of these springs with carbonic acid gas a portion of their virtues may be attributed. In all cases the waters contain saline ingredients which doubtless modify, and generally augment, the operation of the chalybeate element.

3. *Compounds with Mineral Acids.*

Ferri Sulphas.—SULPHATE OF IRON; GREEN VITRIOL.

This salt may be prepared by heating together dilute sulphuric acid and iron wire, evaporating the solution, and drying the crystals. These latter are transparent rhomboidal prisms of a bluish-green color, and of a sweetish ferruginous and astringent taste. They effloresce on

exposure to the air, becoming covered with a powder which is whitish at first, but afterwards grows yellowish or brownish, owing to the conversion of the protoxide into the sesquioxide of iron. Sulphate of iron is soluble in two parts of cold, and more readily still in hot water; but in alcohol is insoluble. It is decomposed by the alkalies and their carbonates, soaps, lime-water, nitric acid, nitrate and tartrate of potassa, iodide of potassium, borate and phosphate of soda, the soluble salts of lime, lead, and baryta, nitrate of silver, the soluble sulphurets, and, unless perfectly pure, by all the vegetable astringents.

Liquor Ferri Nitratis.—SOLUTION OF NITRATE OF IRON.

This preparation is directed to be made by the action of diluted nitric acid upon pieces of iron wire, and is regarded chemically as a ternitrate of the sesquioxide of the iron. By this method it is found that the solution is not permanent. It contains a mixture of the nitrates of the protoxide and sesquioxide of iron, and, on exposure to the air, the former of these becomes oxidized, and a subnitrate of the sesquioxide is deposited. This change may be prevented by the addition of a small proportion of muriatic acid, or, as recommended by Prof. Procter, by gradually adding the iron to the nitric acid so as to insure its complete oxidation. As prepared by the former process, according to the directions of Mr. Kerr, who first proposed this preparation in 1832, solution of nitrate of iron is a transparent liquid, of a dark red color, and astringent taste. Mr. Procter's preparation is of "a bright Madeira wine color."

Ferri Phosphas.—PHOSPHATE OF IRON.

This preparation, obtained by the double decomposition of sulphate of iron and phosphate of soda, is a tribasic salt, consisting of a mixture of the phosphates of the protoxide and sesquioxide of iron with water. Phosphate of iron is a bluish-white powder, insoluble in water, but soluble in diluted nitric and other acids.

4. *Compounds with Organic Acids.*

Ferri et Potassæ Tartras.—TARTRATE OF IRON AND POTASSA; TARTARIZED IRON.

When the hydrated sesquioxide of iron is added to a solution of the bitartrate of potassa at a temperature of 140° , it takes from the salt one equivalent of its tartaric acid, and there is formed the triple salt required. The solution containing it is then evaporated to a syrupy consistence, and spread upon plates of glass or porcelain to dry. As thus obtained it is in transparent, glistening scales of a reddish-brown or dark-red color, which are readily soluble in hot, but imperfectly in cold water. It has a styptic and somewhat acid taste. The addition

of astringent vegetable infusions renders its solution turbid. It is preserved clear, on the other hand, by the addition of ammonia.

Under the name of *Wine of Iron* (VINUM FERRI. *Lond.*) a preparation is made by digesting an ounce of iron wire in two pints of Sherry wine, for thirty days. The bitartrate of potassa in the wine converts a portion of the iron into a tartrate which remains in solution with tartrate of potassa. An equivalent preparation may be more directly prepared by adding a sufficient quantity of Sherry or Rhenish wine to a solution of tartrate of iron and potassa in water.

Ferri et Ammoniaë Tartras.—TARTRATE OF IRON AND AMMONIA.

It may be prepared by adding caustic ammonia to a solution of tartrate of iron, or, as proposed by Professor Procter, by dissolving to saturation freshly precipitated hydrated sesquioxide of iron in a solution of bitartrate of ammonia. This double salt, when made in small quantities, is in brilliant scales, dark-brown in mass, but garnet red by transmitted light. When obtained in considerable quantities, it forms angular grains resembling kino. (*U. S. Disp.*) It has a strongly saccharine, and a slightly ferruginous or styptic taste. It is very soluble in water.

Ferri Citras.—CITRATE OF IRON.

This salt is formed by saturating a heated solution of citric acid with freshly-prepared hydrated sesquioxide of iron, evaporating the solution to a proper consistence, and then drying it in the manner directed for tartarized iron. Trousseau and Pidoux state that unless ammonia is added to the solution, the salt cannot be procured in brilliant and transparent scales. This addition also corrects its styptic taste.

The CITRATE OF IRON AND QUINIA is a preparation formed by boiling together quinia, citric acid, and citrate of iron in water. It is said to contain four parts of citrate of iron to one part of citrate of quinia. In appearance closely resembling the citrate of iron, this salt is very soluble in water, and intensely bitter and slightly chalybeate to the taste.

Ferri et Ammoniaë Citras.—CITRATE OF IRON AND AMMONIA.

The mode of preparing this salt is precisely the same as that above described for the citrate of iron, except that the addition of ammonia is officinal in the present case.

Ferri Acetas.—ACETATE OF IRON.

This preparation is officinal in the Dublin Pharmacopœia, into which it was admitted on the authority of Dr. Percival, and in the form of *Tincture of the Acetate of Iron*. It is a solution of the acetate of the sesquioxide of iron in rectified spirit. This tincture is a reddish-brown

transparent liquid, with an ethereal odor, and an acid, chalybeate taste. (*Neligan.*)

Ferri Lactas.—LACTATE OF IRON.

Gmelin speaks of a chalybeate preparation, *serum lactis chalybeatum*, made by quenehing red-hot iron in whey, as combining an attenuating with a tonie power.¹ Recently Gélis and Conté recommended a lactate of iron prepared by digesting lactic acid upon iron filings. It is also obtained by the mutual reaction of lactate of lime and the sulphate of iron. It crystallizes in plates, or in acicular tetrahedral crystals, which are white when pure, but when impure have a greenish or brownish tint. Its taste is at first sweetish, but afterwards chalybeate and styptic. It is but slightly soluble in water.

Ferri Valerianas.—VALERIANATE OF IRON. *Dub.*

This compound is prepared by a double decomposition between sulphate of iron and valerianate of soda. It is in the form of a reddish-brown, dull powder, with an intense odor of valerian, and with but little taste. It rapidly loses its valerianic acid on exposure to the air.

5. *Compounds of Iron with Halogen Bodies.*

Ferrum Ammoniatum.—AMMONIATED IRON; AMMONIO-CHLORIDE OF IRON.

When muriatic acid is added to the sesquioxide of iron (subcarbonate of the U. S. Pharmacopœia), a solution of the sesquichloride is formed, which is then mixed with a solution of muriate of ammonia, and the mixture evaporated to dryness. The sesquichloride of iron and the muriate of ammonia are not supposed to be chemically united by this process. Ammoniated iron, thus prepared, is in transparent rhombic crystals of a brownish-red or orange color, and of a sharp, saline, and chalybeate taste. It becomes moist on exposure to the air, and has a faint odor of muriatic acid.

Tinctura Ferri Chloridi.—TINCTURE OF CHLORIDE OF IRON; MURIATED TINCTURE OF IRON.

This preparation is a solution of sesquichloride of iron in alcohol, and is made by dissolving sesquioxide (subcarbonate, *U.S.*) of iron in muriatic acid, and, after filtration, adding alcohol. By the latter addition a small proportion of hydrochloric ether is generated, which gives to the compound an agreeable odor. It is transparent, and of a reddish-brown color, but in thin strata is yellowish. It has a very acid and styptic taste. It is chemically incompatible with the alkalis, alkaline earths, and their carbonates, acetate and subacetate of lead, nitrate of silver, mucilage of gum Arabic, tannic acid, and all astring-

¹ *Apparat. Méd.*, pt. ii., i. 333.

gent vegetable preparations. The *perchloride* of iron may be obtained by the direct combination of one part of peroxide of iron with five parts of pure muriatic acid.¹

Ferri Iodidum.—IODIDE OF IRON.

Iodide of iron is prepared by gradually adding iron-filings to a solution of iodine in distilled water, and gently heating, filtering, and evaporating the mixture. Owing to the strong affinity of iron for oxygen, this salt is readily decomposed on exposure to the air. When prepared with due precautions against this change, iodide of iron may be procured in transparent, green, tabular crystals, which, with water, form a pale-green solution; but ordinarily the solution has a brownish tinge, due to the liberation of iodine and the precipitation of a sesquioxide of iron. This change may be prevented by the presence of a small quantity of metallic iron, or by the addition of sugar. The iodide of iron, in solution, is decomposed with great facility by acids, by the alkalies and earths and their carbonates, by tartar-emetic, by most of the soluble metallic salts, astringents, vegetable infusions, &c.

Liquor Ferri Iodidi.—SOLUTION OF IODIDE OF IRON.

This preparation differs from the last by the addition of sugar to the filtered liquor, which, also, is not evaporated. In this manner decomposition is prevented. The solution is of a clear pale-green color, and has a strong inky taste.

Ferri Ferrocyaneum.—FERROCYANIDE OF IRON; PRUSSIAN BLUE.

By the addition of sulphuric acid, and then of nitric acid, to a watery solution of the sulphate of iron, the sulphate of the protoxide of iron is converted into a tersulphate of the sesquioxide, which latter is then decomposed by the addition of the ferrocyaneum of potassium. By a partial double decomposition, sulphate of potassa and ferrocyaneum of iron are produced, the former of which is removed by washing. Ferrocyaneum of iron is familiar as a deep, rich blue color; it has neither taste nor smell, and, when pure, is insoluble both in water and alcohol. It is decomposed by nitric and by muriatic acid.

Ferri Bromidum.—BROMIDE OF IRON.

This compound, which is not officinal, may be prepared by heating bromine and iron filings together in water. It is a deliquescent salt

¹ Under the name of Bestuscheff's tincture (*Spiritus sulphurico-æthereus ferruginosus*, Ph. Bor., Austr., &c.) is a preparation made by dissolving muriate of iron in ether and alcohol. It is a mild chalybeate preparation, which is supposed to be peculiarly adapted to cases of anæmia in which the nervous susceptibility is greatly increased. Other preparations of iron are better adapted to fulfil the primary indication, and, when nervous symptoms occur, Hoffmann's anodyne or some other nervine stimulant can be used.

of a brick-red color, and of a very styptic taste. Like iodide of iron, it is best preserved in a saccharine solution.

HISTORY.—The earliest, and for a long time the only record of the internal use of iron, dates from the sixteenth century before Christ, when, according to Appolodorus, Iphyclus, one of the Argonauts, was cured of impotence by means of iron rust dissolved in wine.¹ In the Hippocratic period and among the Romans at the commencement of the Christian era, ferruginous preparations were employed topically, and almost exclusively as styptics; yet Pliny speaks of water in which iron had been quenched, having been given in many affections, and particularly in dysentery.² The local applications of the rust of iron are thus enumerated by Pliny: it coagulates, dries, and constricts; cures alopecia; with wax and myrtle oil it is used for granulations of the eyelids and pustules of other parts; with vinegar for erysipelas; on compresses for the itch, for paronychia, and for excrescences on the fingers. Applied on wool as a pessary, it controls uterine fluxes; with wine and myrrh is applied to recent wounds, and with vinegar to condylomata. It also allays the pain of gout. Iron scales were employed for similar purposes, and also as a hæmostatic, and Pliny, referring to the last named quality, says that thus iron cures what iron causes. This writer notices particularly its control over enlargements of the spleen, when topically applied, and Dioscorides alludes to its internal use for the same affection.³ A similar statement is made by Celsus and also by Aëtius. To the above account nothing material is added by the Arabian writers; but Rhazes says that iron strengthens the sexual powers. He also states an overdose of iron filings occasions abdominal pain, dryness of the mouth, fever, and severe headache.⁴ Yet the use of iron as a medicine does not appear to have been very general until in the progress of chemistry, various preparations of the metal were applied to the cure of disease. In the sixteenth century (1571), Monardes of Seville published a treatise on the virtues of this metal, in which, for the first time, a just appreciation of their excellence appears. He dwells upon the emmenagogue properties of iron, and of its rendering the barren apt for conception; says that it constricts the stomach, and improves the complexion and appetite, invigorates the liver and the other viscera, contracts the spleen, and strengthens the generative faculty.⁵ But probably the greatest impulse given to the use of chalybeate medicines was derived from

¹ LE CLERC, *Hist. de la Méd.*, p. 28.

² *Hist. Nat.*, lib. xxxiv. cap. 44.

³ *Lib. v. cap. 53.*

⁴ EBN BAITHAR, ed. Sontheimer, i. 295.

⁵ ALSTON, *Mat. Med.*, i. 141.

Sydenham (1681), who prescribed them in ehlorotic disorders with singular suecess, and in the manner which will be deseribed in its proper plaee. In the middle of the last century (1757), Ratty says of chalybeate waters, "they corroborate, cure relaxations, stop fluxes, increase the momentum of the blood, open obstructions, sharpen the appetite, and strengthen digestion."¹ The same author points out all the speeial contraindications to their use which some writers have eonceived to be of reeent discovery.

Action on the Animal Economy.—Menghini demonstrated an increase in the proportion of iron in the blood of dogs whose food had had iron mixed with it.² So Tiedemann and Gmelin, after giving to a horse six drachms of sulphate of iron, found the metal in the venous blood, but none in the lymph. In their experiments, and in all similar ones, iron is found organically incorporated with the red globules of the blood, and not, like other medicinal substances, freely dissolved in that liquid.

The *bile* in its normal state contains iron, but the proportion is increased by ferruginous substances. This was long ago shown in Dr. Mareet's case of a man who was in the habit of swallowing elasp knives. After his death the bile in the gall-bladder was found to be perfectly black, and, upon incineration, it yielded more than double the quantity naturally contained in this secretion.³ After the administration of iron it has been detected in the *milk* of asses and also of women. The *feces* of persons taking iron, exept the preparations insoluble in the stomach and the potassio-tartrate, are generally of a black color, which has been attributed to the formation of a sulphuret of iron in the bowels and also to the action of the tannic acid contained in the food. The latter opinion is probably the most correct, inasmuch as in children at the breast and who therefore use no food containing tannin, iron does not give this color to the dejections; besides which, the teeth are stained by iron even when no sulphurous matter is contained in the food and there are no eruptions of sulphuretted gas, provided that the astringent principle referred to is present in the food.

The quantity of iron seereted with the *urine* is extremely small, and its appearanee in this liquid at all depends somewhat, at least, upon its mode of combination when taken. Among martial preparations, the one which reveals its presenee most distinctly in the urine is iodide of iron; and in this ease the metal is probably earried along with the iodine, the tendency of which to be exereted with the urine is very

¹ RATTY, On Mineral Waters, p. 249.

² BAYLE, Biblioth. de Thér., iv. 223.

³ Med.-Chir. Trans., xii. 62.

remarkable. That, however, iron is sometimes excreted by the kidneys when it is abundantly used, and especially when it is taken in natural mineral waters, is shown by the inky precipitate the urine gives in these cases on the addition of tincture of galls. Iron, too, has been found as a constituent of some varieties of calcareous deposits. Besides these demonstrations, it may be remarked that iron occasionally gives rise to a good deal of vesical irritation, and also, as we have already seen, that the ancients regarded it as an aphrodisiac. The existence of this quality, indeed, does not admit of doubt; but whether it arises from a direct irritation of the genito-urinary apparatus by the medicine, or indirectly from the general improvement in the tone and vigor of the functions induced by iron, is still an open question. Both modes of action are probably real, but the latter is the one most frequently observed.

Among the preparations of iron there are three which may occasion poisonous effects. They are the iodide, the muriated tincture, and the sulphate. In their irritant operation, however, it is not their metallic element which is active; it is the iodic, the hydrochloric, or the sulphuric acid which is the chief cause of the toxic phenomena. Thus, iodide of iron, given to animals in excessive doses, occasions vomiting, purging, gastric inflammation, and death; and the remaining compounds produce inflammation and ulceration of the coats of the stomach. Even in man two of these compounds have had fatal effects. The muriated tincture occasioned death in one case reported by Christison, and a notice of several other cases, in which life was greatly endangered, is contained in Mr. Taylor's work on poisons. In one of these great irritation of the whole urinary system followed, but was speedily removed; in another the mucous membrane of the mouth and œsophagus became hot and dry, and vomiting of blood took place. The sulphate of iron has been taken in the dose of an ounce without causing death; but in other cases death, preceded by vomiting and purging, has occurred. Two such instances may be found in Mr. Taylor's work, and three are recorded by Orfila in which the preparation was administered with criminal intent.

Sulphate of iron, in solution, has produced serious effects by its external application. Pyl relates a case in which the head of a child affected with tinea was washed with a solution of this salt. Severe burning pain of the scalp was followed by thirst, vomiting, and fatal convulsions.¹

Of *ferrocyanuret* of iron Lewis long ago remarked that, as it is not soluble in ordinary liquids (water, dilute acids, alcohol, ether, oil), it

¹ WIEBNER, *Wirkung*, &c., ii. 360.

is the least promising of all the medicinal preparations of iron. Although, when pure, it produces no sensible derangement of function, yet Dr. Jackson saw distressing cerebral and nervous symptoms, obtuseness of the senses, and restlessness, and Dr. Fahnestock delirium, coma, and even death, produced by the preparation which they employed.¹ The experiments of Coullon upon animals show it to be inert even in large doses; indeed, it appears to be unchanged in its passage through the system. If it has seemed to display active properties in the treatment of disease, it is probably because the preparation was impure by containing an excess of hydrocyanic acid or of the protoxide of iron.

The soluble preparations of iron are apt to produce a discoloration of the teeth, which is an effect of the union of the metal with the tannin contained in the food. It is easily removed by means of a stiff brush with charcoal dentifrice, especially if the latter contain tannic acid. The iodide of iron sometimes produces a blue color of the same parts, which may be removed by a solution of the carbonate of soda.

MODE OF ACTION.—Cullen taught that the medicinal virtues of iron entirely depend upon its astringent and tonic powers, and he treats slightly the experiments of Menghini “concerning the iron constantly in the blood of animals, or the manner in which it is introduced into it.”² Wolff, Menghini, and others, had already shown that iron is absorbed from the stomach and bowels; and they taught that it entered the vessels and quickened the languid circulation of the blood in leucophlegmatic and chlorotic persons.³ This statement is in conformity with the opinions of Willis and Sydenham, and of Haller, who maintained, a century ago, that iron imparts its color to the blood. It was thus early recognized that iron is, like cod-liver oil, a nutrient rather than a medicine, since it furnishes one of the most important elements of the organism, and the one which is always deficient in the diseases for which it forms the most effectual, and, as it were, specific remedy.

The most evident effect of iron is that during its administration the blood becomes redder, and its red globules more abundant. The chlorotic girl, or the woman drained of her blood by uterine hemorrhage, so that the liquid in her veins is scanty and almost colorless, have the florid hue restored to their cheeks and the fulness to their veins by means of iron, as certainly as the tertian ague is cured by quinia. That these effects do not proceed from a merely tonic power in the medicine, is proved by the fact that no other tonic, mineral or vegetable, not even bark itself, produces such a change. On the other hand, it is certain that whenever the activity of the circulation is

¹ Am. Journ. of the Med. Sci., iii. 244.

² Mat. Med., ii. 22.

³ Gmelin, App. Méd., pars ii., i. 310.

accompanied with fever, and especially when the blood presents a buffy coat, the administration of iron is injurious.

The red globules of the blood appear to be *the organ* to which iron is especially directed, and by which the activity of animal as well as of organic life, is sustained at the highest point. These bodies it is which by contact with the inspired air in the lungs, attract and become impregnated by oxygen, the essential agent in all the compositions and decompositions which sustain life in the tissues, acquiring thereby the scarlet hue of arterial blood which they lose with their oxygen in their passage through the tissues to the venous system. Thus it would appear that the activity of nutrition, and probably also of calorification, is dependent upon the iron in the blood, and that when the red globules which contain it are most abundant, all of the functions of the economy attain their highest degree of activity and vigor, such as is displayed in persons of a sanguine temperament.¹

In the opposite conditions of the economy, the proportion of red globules in the blood is less than normal, and all experience testifies that it can be restored by no means so readily as by iron. This fact was known long before the blood was ascertained to contain iron, or any definite notion of its operation was entertained. The indications universally recognized for its use were persistent pallor and softness of the tissues with general debility.

It is altogether improbable that iron is merely associated mechanically with the globules. These bodies are living organs, one of whose constituents is iron. It is derived from the animal and vegetable substances which serve as food, and in which it is, for the most part, as vitally combined and as intimately as it is in the organs themselves. In health the appropriation of this essential element is readily performed, but not so in disease. Hence, if the system is, of its own strength, unable to assimilate the iron contained in food which is imperfectly digested, an artificial supply of the element becomes necessary for the restoration of health.

The doctrine that iron is a constituent of the red globules of the blood, and exists in them in definite proportions (forming six per cent. of their hæmatin), appears to be supported by the fact, repeatedly observed, that when this mineral is used by persons who are already in good health, it does not produce nor increase plethora so long as the animal functions are maintained in active exercise. Brandis states that this is of common observation at chalybeate springs, the waters of which are habitually drunk by man and beast without the slightest

¹ BRANDIS, Erfahrungen über die Wirkung der Eisenmittel. Hannover, 1803.

injury. Brück, also, in his experiments upon rabbits, found that for a time a large proportion, or the whole even, of the iron given them was assimilated, but that a point of saturation was subsequently reached, and the iron administered to the animals was evacuated with a trifling loss. Even when in man the administration of iron is unduly prolonged, and produces a plethoric condition of the system, it must be remembered that this plethora is not positively but only relatively, a morbid state, or, indeed, is less a state of disease at all, than one in which disease is imminent, but can be averted by a physiological regimen which shall quicken the organic nutritive changes.

A theory of the operation of iron, proposed in conformity with these and other facts observed in the use of ferruginous preparations, and which appears to possess a strong degree of probability, is the following: Iron, on entering the bloodvessels, combines immediately with the corpuscles which have not yet acquired, or which have lost more or less of their ferruginous element. It enters the blood as a chloride, is decomposed, combines with the corpuscles as a carbonate of the protoxide of iron, and in the lungs gives up carbonic acid and absorbs oxygen, and is thereby converted into a peroxide. The white corpuscles are destitute of iron, but when once saturated with it neither they nor the red corpuscles can receive any more.¹ It is this theory, we repeat, which explains the fact pointed out by Brandis, Giacomini, Brück, and many others, that iron ceases to influence the economy when it has once restored it to a healthy condition. It has been remarked of that portion of the theory which regards the iron as a protoxide on entering the blood, and as becoming peroxidized in the lungs, thus making the red globules the carriers of oxygen to the tissues, that we have as much reason for supposing the iron to be absorbed originally as a peroxide, and as parting with an equivalent of its oxygen in the tissues, but regaining it when it traverses the lungs. Still, this view does not impair the theory first propounded by Liebig, that the red globules carry oxygen from the lungs to the tissues, and carbonic acid from the tissues to the lungs, in performing which service it wears by turns the scarlet hue of arterial and the crimson color of venous blood.

Certainly, one of the most curious examples of the power of a theory to warp even an acute and ingenious mind is presented by Giacomini's assertion that iron, far from being a tonic, is a sedative. He affirms that fifteen grains, or, at most, three times that quantity of carbonate of iron, render the pulse slow and feeble, and the skin pale, and occa-

¹ SELADE, Canstatt's Jahresbericht, 1846, p. 234.

sion chilliness, general debility, and trembling of the limbs. In order to meet the palpable objection to this notion, that iron raises the tone of all the functions, he affirms, not only that it has no such effect upon men in a healthy state (which, however, is not the question), but that in diseases in which it is advantageous, it only *appears* to have this effect; that then in reality, the "vital powers are not deficient, but, on the contrary, are accumulated in excess, and, so to speak, are smothered and weighed down by the violence of the disease, and that they only need to be diminished in order to bring them into equilibrium with the state of the system."¹ It is evident that these are mere phrases with which the author of them deceived himself, and misled those who are disinclined to look narrowly into a medical theory which an eloquent advocate or a sophistical reasoner has persuaded them to adopt.

Undoubtedly iron is, according to its combination, tonic (reconstituent), or astringent. The latter quality is most conspicuous when it is united with a mineral acid; the former when it is given in the negative metallic state and combines with the acid of the stomach, or is administered in combination with halogen bodies or with organic acids. In general it is contraindicated by vascular excitement, plethora, congestion, and inflammation. It must be given with great circumspection to thin persons of a dry and irritable constitution; also when there is dyspepsia with bilious derangement, phthisis in the stage of softening, or chronic bronchitis with purulent expectoration and hectic fever.

THE PREPARATIONS OF IRON COMPARED.—If an insoluble preparation of iron is introduced into the stomach, and is susceptible of being acted upon by the gastric juice, it unites with the latter more or less; and if a soluble compound is so introduced it is more or less precipitated, the gastric acids uniting with its base. Thus it is evident that the quantity of iron absorbed from the stomach depends upon the quantity of the metal which is taken and which remains soluble or is rendered so by the gastric juice. Those preparations which are with difficulty attacked by this liquid, and remain undissolved, are therefore the least adapted for medical use. But, however theoretically the insoluble preparations may appear to be least fitted for medical use, they are, nevertheless, among the most certain in their effects, provided that the acid secretion of the stomach is sufficiently abundant to saturate them. In order to secure this object, the doses of iron should be small and frequently repeated, especially if taken

¹ Mat. Méd.; Trad. Fran., p. 372.

when the stomach is empty ; but when this organ contains food and the supply of gastric juice is abundant, the dose may be augmented. Other things being equal, it is probable that preparations of the protoxide are more efficient than those of the peroxide, because in the same bulk they contain a larger proportion of iron.¹ It should not be forgotten that whatever portion of an insoluble preparation of iron is not appropriated by the gastric acids must enter the intestine unchanged, and that it sometimes occasions there annoying irritation. It may even in the case of precipitated carbonate of iron accumulate and form large concretions in the bowels. Examples of this occurrence were formerly not infrequent. If the soluble salts of iron are decomposed in the stomach, as appears to be probable, they possess no special advantage over the insoluble preparations. There is one among them, however, which, if it forms an exception to the rule, as it is believed to do, must offer advantages that will presently be pointed out.

Modern chemical science has carefully investigated the changes which the several preparations of iron undergo in the economy, and the conclusions arrived at by Quevenne, Bouchardat, Mialhe, Mitscherlich, and others, appear to be confirmed equally by physiological considerations and by experience. Without being in all cases identical, they are sufficiently analogous to serve as a key, if not always as a guide to practice.

It appears to be ascertained that all of the soluble salts of iron are more or less precipitated by the gastric liquids, including mucus and the organic principles of the food, which form with the precipitate an insoluble compound. Mialhe holds that even the insoluble preparations are at first rendered soluble by the gastric juice, and then precipitated by an excess of the same liquor, to be redissolved on reaching the duodenum by the bile, pancreatic juice, and other alkaline secretions of this portion of the intestinal canal. He also maintains that the potassio-tartrate of iron forms an exception to this rule, and that having been absorbed without undergoing any material change or loss, it is transformed into a carbonate of iron in the blood. Each of the preparations of iron which are capable of modifying the composition of this liquid, is supposed to enter it in some combination, which, whether original, or resulting from reactions that occur in the primæ viæ, is decomposed by the free or carbonated alkalis of the blood, so

¹ Every fifty grains of the following preparations contain the proportion of metallic iron, set after their respective names : Iron, reduced by hydrogen, 50 grs. ; black oxide, 36 grs. ; protocarbonate, 25 grs. ; protochloride, 21 grs. ; persulphate, 14 grs. ; tartrate of iron and potassa, 11 grs. ; protosulphate, 10 grs. ; lactate, 10 grs.—SOUBEIRAN, *Bull. de Thérap.*, xlviii. 307.

that iron probably arrives at its ultimate destination in the globules as an oxide (peroxide).

If these views are admitted, it follows that unless a chalybeate preparation which is soluble in the gastric juices be also susceptible of precipitation from solution in them by the free alkalies or their carbonates, it cannot modify the composition of the blood. This is the case with the cyanuret and the sulpho-cyanuret of potassium and iron (yellow and red ferro-prussiates of potassa), which are consequently discharged with the urine, while other compounds of iron appear but slightly in this secretion.

It may now be found instructive to inquire what are the peculiarities which distinguish the action of the chief ferruginous preparations from one another. *Metallic iron* in its proper medicinal forms is readily acted upon by the gastric liquids, and the more so when it is minutely divided as in the case of iron reduced by hydrogen. An objection to iron filings has long existed, which is that they occasion offensive eructations of sulphuretted hydrogen. They are presumed to arise from a combination of the sulphur usually contained in iron with hydrogen, evolved during the oxidation of the iron by the gastric liquids. When iron is very pure, as in the case of Quevenne's preparation, this effect is not observed, or is so in a slight degree only. The *oxides* (carbonates) of iron are more bulky preparations, and although less generally used at present than formerly, are, nevertheless, efficient chalybeates. As the protoxides, by exposure to the air absorb oxygen and thus become less soluble in the gastric liquids, the preparation in which the oxidation is prevented, to some extent, by honey (*Pilulæ Ferri Carbonatis*), has taken the place of the others in practice, and is with Quevenne's iron the most efficient of all the insoluble preparations.

Of the compounds of iron with mineral acids the *sulphate* has too much astringency to be used as re-constituent of the blood, unless in a very largely-diluted solution. In that condition it exists in some of the most celebrated chalybeate waters. It must be speedily decomposed in the stomach. The same remarks are applicable to the *nitrate* of iron, but in a less degree. The *phosphate* stands in an intermediate position between the mineral and the organic compounds of the metal, relatively to its energy, it being less astringent than the former and less gentle in its operation than the latter.

Among the compounds of iron with organic acids, the *tartrate of iron and potassa* is by far the most important, for it is one of the most valuable of the chalybeate preparations. As Mialhe and Quevenne have remarked, it is at once the richest in iron, the most agreeable to

the taste, the least irritating to the bowels, and oppressive to the stomach, the least apt to occasion constipation, and the most readily absorbed of all the soluble ferruginous preparations. According to Mialhe other soluble compounds of iron are precipitated in the stomach, and so much of them only can be absorbed as is re-dissolved by an excess of acid. He claims to have shown, that although this salt, like others of its class, is precipitated in the stomach, "yet, on reaching the intestine and there coming in contact with the alkaline secretions it is not decomposed; and, as the acid which occasioned its precipitation in the stomach unites with the alkaline bases, the iron resumes the solubility which it had temporarily lost, and becomes apt for absorption throughout the whole intestinal tube, so that it can be administered as effectually by the rectum as by the mouth."¹ If this view of its operation be correct, the medicine must possess the singular advantage of not being dependent, like the other most useful preparations, upon the gastric acids for absorption. Indeed, they interfere with rather than promote this process, and, as Quevenne has observed, the most favorable time for administering the tartrate ought to be between meals, when the stomach contains no acid.

The *lactate* is regarded by some authorities as preferable to other salts of iron, because its acid is presumed to be the same that normally combines with this metal in the stomach. But there is no sufficient ground for adopting this opinion as the basis of a practical method. The *citrate* of iron is even more tasteless than the tartrate of iron and potassa, and is an excellent preparation when the stomach is delicate. The *citrate of iron and quinia* had no demonstrable advantage over an extemporaneous union of these medicines; and the *citrate of iron and ammonia*, although it is a compound of the same nature as the tartrate above described, is inferior to the latter for all the purposes to which chalybeate medicines are applied. The *acetate* and the *valerianate* have no peculiar virtues to recommend them. The *tincture of chloride of iron* is of all ferruginous compounds the one that exerts the most powerful local action as a styptic, and indeed as a caustic upon delicate tissues. Hence, even when given largely diluted, it probably coagulates the mucus and constricts the lining membrane of the stomach. A diuretic operation is attributed to the medicine, which is due either to its acid constituent, or, according to Headland, to "a peculiar ether formed with the spirit by an excess of hydrochloric acid used in the preparation of the tincture." It is not a medicine that would generally be selected to combat symptoms of anæmia unless a hæmostatic operation

¹ Chimie Appliquée, p. 326.

were indicated at the same time. The *perchloride* of iron in solution has all the astringency of the last preparation, and is without caustic qualities. The tincture of Bestuscheff is believed to possess qualities which adapt it to occasional use in cases of slight anæmia with great nervous susceptibility.

The *iodide* of iron, according to Cl. Bernard and M. Gille,¹ is the only known ferruginous preparation the iron of which can be detected in the saliva and milk, as well as in the urine, and on that ground a peculiar efficiency is claimed for it. On the other hand, Mialhe and Quevenne, and also Trousseau, who adopts their conclusions, believe that the iodide is no sooner introduced into the economy than it is decomposed, "the iron being retained and the iodine rejected." These writers go so far as to recommend, as being preferable to the iodide of iron, the simultaneous use of some other preparation of iron and of the iodide of potassium. It appears, then, that respectable authorities are at issue in regard to a point of fact. Therapeutists, meanwhile, who have observed the effects of the compound in question, are quite agreed that they are such as partake of the effects of iodine as well as of iron, and consequently that, if the iodine of the compound is rejected, it is not so in such a degree as to interfere with its special therapeutic operation.

Prussian blue, the *ferrocyanide* of iron, when pure, is probably but little acted upon by the gastric juices. The alkaline secretions of the small intestine are said to produce no other effect upon this substance than to convert it partially into the yellow hydrocyanate of potassa and iron, which is likewise inert. The Prussian blue of commerce, however, contains, according to Mialhe, a certain portion of oxide of iron, which is, of course, susceptible of solution in the gastric acids.

REMEDIAL EMPLOYMENT. *Anæmia and Chlorosis*.—There is a class of diseases which have sometimes been grouped together, and under various names, in all of which there is a deficiency of the proportion of red globules in the blood, and in some of them another morbid element in addition. The principal affections of this class are, anæmia (the idiopathic form is here mainly intended), chlorosis, hypochondria, the state of convalescence from exhausting diseases, the cachexia produced by marsh miasmata, some forms of dyspepsia, and also of general dropsy.

The symptoms which are common to these disorders are very conspicuous in chlorosis. The most important of them are the following: a dingy or greenish pallor of the skin, colorless and shrivelled lips,

¹ Monographie de l'Iodure de Fer, p. 42.

pale, soft, and in protracted cases, a shrunken condition of the gums. The skin has lost its elasticity; the cellular tissue is often œdematous, especially under the eyes and around the ankles; the hands and feet are habitually cold, the muscular strength is impaired, and slight exertions occasion great fatigue; the peristaltic action of the bowels is diminished, owing partly to the diminished secretion of the liver, and in part, also, to debility of their muscular coat. During the digestive process the coldness of the hands and feet increases, and is often accompanied with gastric uneasiness and a sense of general discomfort, and with palpitation of the heart. If a person presenting these symptoms loses blood, they are all greatly aggravated, fatal syncope is threatened, and the blood itself is pale and watery. The pulse is usually small and quick, and is rendered unnaturally frequent by exercise, mental excitement, or laborious digestion. Sometimes, indeed, distinct and regular febrile paroxysms occur, and this circumstance it is which gave to chlorosis the expressive name of *febris alba*.

Even more striking than these are the phenomena which the nervous system presents. *Sanguis moderator nervorum* is an old and true aphorism. When the constitution of the blood is impaired and deteriorated by a partial loss of the red globules, the energy of nervous acts and their co-ordination are alike impaired, and the nervous system falls into irregular action. It displays an unnatural sensibility to external impressions, especially a want of tone which places it at the mercy of every transient influence, and leads the mind to form exaggerated estimates of pleasurable as well as painful sensations. Muscular quivering and spasms, fits of fainting, obstinate vomiting, causeless bursts of laughter or floods of tears, these are the common phenomena of chlorotic hysteria. They are not the effect of weakness merely, for in exhausting diseases of the lungs or bowels no such effects occur; on the contrary, the victims of phthisis are, above all, remarkable for the hopefulness and calm which attend their gradual decline. Although these symptoms are common in chlorosis, they are by no means so frequent in simple anæmia, in which the patient gradually wastes and withers without any evident cause, and in which also the nervous susceptibility has a more purely physical and less of a mental character.

The shortness of breath on muscular exertion, which is common to all forms of anæmia, results directly from a diminution in the proportion of the red globules of the blood, and seems to be explicable by the diminished power which the blood then has of receiving or attracting the oxygen of the air, and, in this way, of imparting vigor to all of the functions. Evidently every muscular exertion must increase the de-

mand for oxygen in the lungs, and consequently quicken the circulation and the respiratory movements; when, therefore, as in anæmia, the blood is impoverished, and the nervous system is feeble as well as morbidly excitable, the strenuous exertions made to accomplish the oxygenation of the blood soon exhaust the strength and occasion hurried and panting respiration, and may even paralyze the heart and induce fatal syncope.

The digestion cannot be normal when the blood has ceased to be so. The appetite fails, or is irregular, or there is a craving for unwholesome food, or whatever is taken seems not to nourish the body, no matter in what quantity it may be consumed. The abdomen is usually distended, and the bowels obstinately constipated.

In the chlorotic female a symptom is usually present which, even more than the external aspect, seems to characterize the disease—a *scanty, irregular*, or, with both of these conditions, *painful menstruation*. The menstrual disorder is often regarded as the starting-point of the symptoms of chlorosis; but however this may seem to be in some cases of the disease following a sudden suppression of the catamenia, it is not the less certain that chlorosis is much more frequently a cause than an effect of imperfect menstruation. Indeed, the disease is sometimes met with, complete in every possible particular, in persons of the male sex.¹ It is of the highest importance not to lose sight of this fact when we attempt to cure chlorosis by means of remedies addressed to the general system, and mainly to the blood; and it leads us, with Sydenham, to regard as quite secondary the use of remedies which have a special influence upon the reproductive organs of the female. This eminent physician was the first who gave the true indications for the use of iron as a reconstituent of the blood in chlorosis, and in the cachexia produced by malarial poison. In his day these affections, as indeed all others, were treated mainly by evacuants and nervine stimulants, the former of which tended to perpetuate the condition which the latter could at best but palliate. While he distinctly laid down the proposition that “the chief curative indication is the restoration of the blood,” he was to that degree swayed by the doctrines of his age that he used evacuants whenever they could be borne, even while he acknowledged that they often render the condition of the patient worse. But, having paid this reluctant tribute to an established doctrine, and having dismissed it with the sarcasm that if some recover after using evacuants as well as chalybeates, “such cases say more for the virtue of the iron than for the skill of the doctor,”

¹ Uzac, De la Chlorose chez l'Homme. Paris, 1853.

he advises that the medicine should be administered for thirty successive days. "It is sure," he says, "to do good. To the worn-out and languid blood it gives a spur or fillip, whereby the animal spirits, which before lay prostrate and sunken under their own weight, are raised or excited. . . . The pulse gains strength and frequency, the surface warmth, and the face (no longer pale and deathlike) a fresh, ruddy color."

But while this is true in its application to those cases of anæmia which are of recent occurrence, and in which, therefore, the altered constitution of the blood has not occasioned any radical change in the nutritive function, the case is different when the morbid habit has become fixed, and every organ and every function has departed from its healthful state and action. Although the restoration of the normal composition of the blood is the first and the essential step in the treatment, other means will be necessary to remove the results of a deranged nutrition. Indeed, it is often only by invigorating the system by means of various stimulants that the iron can be digested, and applied to its proper purpose. It cannot be too often repeated that in anæmia iron is food, and is medicinal only in so far as it is assimilated, which it will not be unless the system is stimulated by exercise, fresh air, bathing, change of scene, &c. In some cases, it has been remarked by Trousseau, iron, after having for a time diminished the symptoms of chlorosis, suddenly becomes inoperative, or is no longer tolerated. This singular fact appears to admit of explanation. The blood having received all of the iron it is physically capable of receiving in its impaired condition, the improvement of the health is suspended; but, if by other medicinal and by hygienic means the appropriative power of the system is increased, the iron begins anew to be assimilated. In regard to almost every article of food, and especially in regard to those which have the strongest flavor, it is proverbially true that a continued and exclusive use of them breeds disgust.

There is a gastric debility which sometimes renders the digestion of iron and of all nutriment extremely imperfect, until the administration of acid, alcoholic, or bitter stimulants enables the stomach to perfect the conversion of the medicinal iron into a constituent of the living body. Or there may be an irritability of the bowels with a constant tendency to diarrhœa, which must be checked by appropriate remedies before the administration of iron can become useful or even safe; or, finally, there may be a liability to be unpleasantly affected by some preparations of the metal, when a patient trial of other forms or combinations may be crowned with complete success. To look upon iron as a specific medicine which must necessarily cure

anæmia, under whatever form or with whatever complications it may occur, is to lose sight of the plainest teachings of experience in regard to the curative operation of all drugs whatever. It is by a skilful discrimination of the peculiarities of individual cases, and a judicious adaptation to them of remedial measures, that the true physician is pre-eminently distinguished from the routine practitioner.

In regard to the choice of preparations, it is possible that every one of them may have its peculiar and exclusive advantages, yet the universal agreement of those physicians who are most competent to judge in the matter has determined the question differently. Upon this point Sydenham suggests a criticism, which would not be altogether misplaced at the present day. Steel, he says, "is best given in substance; in which form I have neither seen nor heard of its doing mischief. Nay, the simple substance effects a cure both more surely and more quickly than any of the current preparations. With steel, as with other more famous medicines, the officious sedulity of the chemists has not only failed in adding to its activity, but has succeeded in diminishing it."¹ Next to steel Sydenham preferred a syrup made from Rhenish wine in which iron or steel filings had been steeped. This was really a syrup of the tartrate of iron and potassa, a preparation which, as elsewhere stated, we regard as worthy of the first place among ferruginous medicines, on account of the facility of its administration, its acceptableness to the stomach, and its probably conveying into the blood a larger portion of iron than other preparations of its class. It should generally be given when the stomach is empty.² The less soluble forms of this medicine, particularly metallic iron, either procured by filing or in the purer state of iron reduced by hydrogen, and the so-called carbonates, including Vallet's ferruginous mass, are all very efficient preparations, and, in spite of theoretical preferences for one or another of them, are of nearly equal efficacy when given in the same proportionate dose. They should seldom be taken on an empty stomach, especially the more bulky of them, for they then are apt to cause oppression and heartburn; but should be given immediately before or after a meal so as to insure their solution in the gastric liquids.

Several combinations of iron have enjoyed a peculiar vogue in the treatment of chlorosis. Among these are Blaud's pills, which are

¹ Works, Syd. Soc. ed., ii. 98.

² Dr. Tully, it may be mentioned, pronounces "the supposed tonic effects" of this salt "a delusion," and maintains that the antiphlogistic action of the tartrate of potassa "must more than countervail the feeble tonic power" of the small quantity of iron, with which it is associated.—*Mat. Med.*, p. 1101.

made of sulphate of iron and carbonate of potassa, between which, doubtless, a double decomposition is partially effected. They enjoyed and still enjoy a great repute in France, where their efficacy has been attributed in part to their alkaline ingredient. They are, however, given in very large doses. Griffith's mixture (*Mistura Ferri Composita*), made of the same active materials, with the addition of myrrh, has been widely esteemed for its efficacy in anæmia with amenorrhœa; and Bestuscheff's tincture, into which Hoffmann's anodyne enters, is an agreeable form for administering a nervine with iron when hysterical or nervous symptoms attend chlorosis.

Menstrual Derangements.—Of these there are several forms in which iron displays specific virtues, because they all ultimately depend upon a deficiency of red globules in the blood; but they are modified by the special condition of the patient. In that simple variety of uterine disorder in which at monthly periods or oftener, the female loses a large quantity of imperfectly coagulating blood, which with each returning menstrual epoch grows more watery, while the general symptoms become more and more those of anæmia, iron alone will usually be found sufficient for a cure. The normal state of the blood having been once restored, the menstrual hemorrhage and the anæmia terminate. There are cases, on the other hand, of simple anæmia in which the menstrual discharge is merely scanty or suppressed, accompanied in the former case with some degree of uterine pain, and in the latter replaced by an ineffectual and painful effort recurring, with more or less regularity, at monthly periods. Such cases are usually cited as indicating torpor of the uterine system; and, it is certain that in their treatment an almost essential adjunct to iron consists in the use of aloetic laxatives and such general hygienic measures as tend to stimulate and strengthen all the functions of the economy. Again, menstrual derangement may be attended with symptoms in which nervous disorders play the principal part, but not disorder of the hysterical kind. The uterine loss is trifling, but it is effected with throes of pain which are only less intense than those of childbirth, while the hands and feet are very cold, and the head hot; a fibrinous cast of the uterine cavity is thrown off and the catamenial period is preceded and followed by a leucorrhœal discharge. Under these circumstances the mere administration of iron would be more mischievous than useful, because there is a local derangement, a chronic congestion probably, associated with, and partly, indeed, dependent for its continuance upon the impoverished state of the blood. This local condition must first be moderated by cupping and counter-irritation of the sacrum, by laxative medicines, and by suitable

exercise, before ferruginous medicines will restore the natural flow of the catamenia.

Hemorrhage.—Iron is totally inadmissible in all cases of active hemorrhage, and its usefulness is proportioned, on the other hand, to the passive character of the loss of blood. Whenever this depends upon an impaired constitution of the circulating fluid consisting in a deficient proportion of the red globules, iron is the specific remedy; but in scorbutic affections in which the fibrinous element or the vital condition of the blood is impaired, the value of iron is subordinate to that of the vegetable acids. Uterine hemorrhage of the passive form is that in which the medicine is most effectual. It is contra-indicated whenever the disorder is dependent upon plethora. In appropriate cases, also, iron forms the best prophylactic, by rendering the blood too dense for passive exudation, and in these the preparations are most appropriate which are mildest in their local operation, and are longest retained in the system. To produce a directly hemostatic effect, the muriated tincture and the perchloride of iron are by far the most efficient preparations; and next to these the sulphate. Thus in passive hemorrhages from the stomach, bowels, uterus, or urinary passages, the two former are not excelled by any other medicines. How far the efficiency of the first is due to the iron, and how far to the acid of the compound, is, perhaps, an unsettled question. It should be borne in mind that all preparations of iron are of doubtful advantage and sometimes are positively detrimental, when even without a positive state of plethora, there is a local debility of certain parts tending to a state of disorganization. This is strikingly the case in tuberculosis of the lungs. In that affection iron will even increase the probability of hemorrhage by augmenting the bulk of the blood and the force of the circulation, unless administered with a careful reference to the ability of the system to sustain the increased tension of the bloodvessels. The same remark is applicable to the treatment of ulcerated cancerous and other tumors.

Nervous Affections.—*Neuralgia.* Neuralgia of the fifth pair of nerves has long been treated successfully by means of iron, especially, if not exclusively, those cases in which the disease depends upon, or is at least associated with, general debility and anæmia. It was first recommended by Dr. Hutchinson,¹ who made use of the precipitated carbonate, and in much larger doses than it had been customary to give in other affections, viz: from two scruples to a drachm two or

¹ Cases of Neuralgia Spasmodica, commonly called Tic Douloureux, successfully treated, 2d ed., Lond. 1822.

three times a day, for many weeks together. He was careful not to employ it whenever inflammatory symptoms were present, and always used "collateral means of relief in conjunction with the iron." Many English and some continental physicians published isolated cases showing the success of this method. Among them were some examples of amaurosis with severe neuralgia of the fifth nerve, as in a case of Dr. Belcher.¹ Other instances of the cure of various forms of neuralgia are recorded by Wolff,² Duparcque, Melier,³ &c. The cases of external neuralgia which are most amenable to this remedy are undoubtedly those in which the fifth pair of nerves is affected. Neuralgia of the intercostal and lumbar nerves often yields to it, and occasionally that of the arm; but neuralgia of the lower extremities is more curable by a different class of remedies. Of internal neuralgia, that of the stomach is the only one that is much benefited by iron, and this especially when it is associated with general anæmia in the female, and particularly with uterine derangements and leucorrhœa.

Chorea. Iron was first used systematically as a cure for chorea by Dr. Elliotson, who published eight cases of its successful administration.⁴ He did not find "even headache, vertigo, and symptoms of a degree of paralysis" to interfere with its advantageous employment. But he evidently refers to these symptoms only as they accompany anæmia. Dr. Elliotson found it necessary to continue the use of the medicine for six or eight weeks or even longer.⁵ M. Faivre d'Esnans professed to have cured chorea with prussiate of iron in the space of from four to eight days. He administered a little more than half a grain of the medicine three times a day.⁶ It is true, also, that he gave valerian freely. Mr. Peacock has reported two cases cured by carbonate of iron.⁷

Some other nervous affections have occasionally been benefited by preparations of iron. Dr. Elliotson has reported a case of traumatic *tetanus* which recovered under the use of the subcarbonate.⁸ Mr. Cline found the muriated tincture successful in overcoming *spasmodic retention of urine* connected with stricture of the urethra.⁹ *Seminal emissions*, independent of any general or local excitant, are greatly benefited by the carbonate and other preparations. *Insanity*, of the hypochondriac or hysterical sort, in anæmic persons, is beneficially affected by these medicines, particularly when they are combined with narcotics. Un-

¹ Edinb. Med. and Surg. Journ., xxv. 37.

³ BAYLE, Bibl. de Thérap., iv. 285.

⁵ Pract. of Med., 2d ed., p. 695.

⁷ Times and Gaz., April 1855, p. 410.

⁹ Med. Records and Researches, p. 83.

² Journ. des Progrès, iii. 237.

⁴ Med.-Chir. Trans., xiii. 244.

⁶ Lancet, April 6, 1850, p. 413.

⁸ Med.-Chir. Trans., xv. 161.

der a similar state of the system, Dr. Stanger found sulphate of iron successful in curing an obstinate spasmodic cough which had resisted the use of narcotics.¹ Steymann first proposed carbonate of iron as a remedy for *whooping-cough* during the convulsive stage of the disease. He prescribed about one grain every three hours, and gradually increased the dose to three or four grains.² Lombard, of Geneva, imitated this practice, and Dr. Graves employed it with advantage. Chisholm,³ and also Thierfelder, recommended it, and Elliotson, Stanger, and Rees, used the sulphate of iron with much benefit. The idea originally entertained that iron is a specific for whooping-cough, is now abandoned, but the medicine continues to be prescribed in cases of feeble and scrofulous children, with a hereditary tendency to tubercles, when no inflammatory complication opposes its use.

Chronic Intermittent Fever. In 1822, the Prussiate of iron and potassa was recommended by Dr. Zollickoffer, of Maryland, as a substitute for bark in the cure of intermittent fever in cases where the latter could not be borne, or when, as in children, its administration was difficult. His favorable accounts of its operation were confirmed by Hosack and Eberle, and by Dr. Jackson, of Northumberland, Pa.,⁴ who prescribed it in doses of from one to two drachms during the apyrexia. It was partially recommended also by Fahnestock, who, however, alleged that in some cases it produced "violent cerebral excitement, excruciating pain in the temples, restlessness, and delirium, and in one case death."⁵ It is certain that a very impure preparation must have been used in these cases. Owing partly to such statements, but still more to the introduction of quinia, the use of Prussian blue appears to have been abandoned.

The cachectic and anæmic condition resulting from chronic intermittent fever, and still more from a prolonged residence in malarious districts, and which is the cause of great bodily debility, mental irresolution, and susceptibility to repeated attacks of the disease, has long been treated by ferruginous medicines, which restore the blood to its normal condition, and thus infuse new life and activity into all the functions. The reader will have noticed that iron was anciently esteemed one of the most efficient remedies for enlargement of the spleen. Modern observation has confirmed this opinion so far as the engorgements in question result from periodical fevers, or the habitual operation of their cause. They are then generally connected with a greater or less degree of anæmia. In most instances the efficacy of the

¹ Med.-Chir. Trans., i. 13.

² Bull. de Thérap., xiv. 148.

³ Month. Journ. of Med. Sci., ii. 22.

⁴ Am. Journ. of Med. Sci., ii. 335.

⁵ Ibid., iii. 244.

medicine is greatly increased by its being associated with the preparations of bark. M. Cruveilhier was one of those who in recent times drew particular attention to this quality of iron.¹ The sulphate and the carbonate of iron, the citrate of iron and quinia, and the persesquinitrate of iron, have been employed successfully under the circumstances referred to. The last named preparation has been recommended by Mr. Kerr,² and we imagine that, possessing as it does, like the muriated tincture, direct tonic as well as reconstituent properties, it may be superior to the milder and the less soluble salts.

Abdominal Affections.—In those forms of *dyspepsia* which depend upon general debility and impoverishment of the blood, as in chlorosis, iron is often essential to the cure. Some of its preparations also, especially those combined with a mineral acid, may act as local stimulants. In other cases it is most effectual when associated with bitter tonics, and especially with quinia. When the stomach is irritable the combinations of iron with vegetable acids are peculiarly advantageous. When constipation is present in anæmic cases, iron is sometimes adequate to the cure, by imparting an increased tone to all the functions, and probably also by augmenting the nutrition of the muscular coat of the intestines. Under other circumstances, all of its preparations, except the potassio-tartrate, tend to produce constipation, and make it necessary to prescribe laxatives from time to time.

Albuminuria. The treatment of this affection generally pursued is based rather upon its ultimate effects in the kidneys than upon a just notion of its mode of origin. The more the disease is studied the more probable does it become that the renal lesion, like tuberculization of the lungs, is the effect of a general morbid state, and that the only treatment adequate to arrest its progress must be addressed not so much to the kidneys as to the blood. To be successful, also, it must be employed as early in the disease as the local inflammatory symptoms will permit. The anæmic aspect of persons laboring under albuminuria has been repeatedly described, and is sufficiently apparent, and several writers have incidentally suggested the use of iron to combat this symptom, while they still relied upon local applications as their chief resource. Undoubtedly that form of the disease which is best adapted to the reconstituent treatment is the congestive, when it is unattended with fever, or when the febrile reaction has been subdued and the dropsy reduced by purgatives and saline diuretics. Dr. Lees, of Dublin, was the first to demonstrate the value of ferruginous

¹ Dict. de Méd. et de Chir. Prat., Art. Fer.

² Month. Journ. of Med. Sci., xiii. 336.

medicines in the chronic forms of the disorder. He employed the ammonio-tartrate of iron in doses of ten grains three times a day. Dr. Owen Rees would restrict the use of chalybeates still more absolutely to the chronic varieties; and, while admitting that there is little hope of effecting a cure, he dwells upon the important indication of supplying red corpuscles to the blood. He sometimes prescribes the preparation named above, but prefers the compound iron mixture, or the wine of iron.¹ In dropsy dependent upon engorgement of the spleen, this class of medicines is of primary importance; and the same may be said of general dropsy following miasmatic fevers.

In nearly all *chronic mucous fluxes* the sulphate and the muriated tincture of iron possess unquestionable advantages. In leucorrhœa and blennorrhœa, chronic mucous diarrhœa, bronchorrhœa, and also in passive sweats, they are frequently of essential service, provided that no inflammatory fever exists. In atonic mucous diarrhœa the persesquintrate of iron was originally recommended by Mr. Kerr,² and has since been found useful by many physicians, among whom may be numbered Drs. Neligan and Graves, of Dublin,³ and Dr. Adams, of Michigan.⁴

Intestinal Worms. Iron is usually ranked among anthelmintic medicines. It is possible that iron filings may occasionally destroy these parasites by a mechanical operation. *Tænia* is said to have been removed by sulphate of iron. But, in general, ferruginous preparations are only to be relied on when the patient is in that cachectic state which favors the generation of intestinal worms, and by the cure of which the conditions of their continued existence are also removed. Probably the medicine is more successful in preventing their reproduction, after their expulsion by proper medicines, than in destroying them by virtue of any direct anthelmintic quality.

Consumption of the Lungs. As long ago at least as 1803 it was known that iron is often a mischievous medicine in consumption. At that time Brandis pointed out the evils of an inconsiderate use of chalybeate waters in this disease; Richter states that experience shows ferruginous preparations to be seldom well borne by the phthisical; and their observations have been confirmed by writers of the present day. In truth, it is only in an advanced stage of the disease that a true anæmia exists, and even then the alterations of the pulmonary structure are such as tend to induce congestion, and even inflamma-

¹ Nature and Treatment of Diseases of the Kidneys, &c., p. 89.

² Edinb. Med. and Surg. Journ., xxxvii. 99; Month. Journ. of Med. Sci., viii. 784.

³ Lond. Med. and Surg. Journ., May, 1835. ⁴ Am. Journ. of the Med. Sci., xxiv. 61.

tion. These processes are still more apt to be established in the earlier periods of phthisis. At every period a medicine, the direct agency of which is to augment the quantity and the crisis of the blood, without directly improving the nutrition, cannot fail to promote the pulmonary derangement referred to, and to increase the chances of hemorrhage. Whatever advantage the preparations of iron may afford the consumptive by improving the crisis of the blood, are more than counterbalanced by this increased tendency to congestion and inflammation which they develop, and, above all, to hemorrhage of the lungs. While, however, these objections exist to iron as a remedy in phthisis, there are qualifying considerations which ought not to be overlooked. The danger that has been pointed out arises from the blood having been rendered too abundant and too rich for the wants of the system. But if, simultaneously with the use of the medicine, means are taken to employ the excess of blood for the purposes of nutrition, iron may become of great value in the plan of treatment. If, for example, the patient is directed to use as much exercise as possible in the open air, to increase the action of the skin by frictions, and, in the proper season, by cold bathing, and, at the same time, to avoid all merely stimulating drinks, he will probably be benefited by the use of iron. This, at least, is the case in the more chronic forms of the complaint, and before hectic symptoms have appeared. The medicine should also be suspended, or its dose diminished, whenever oppression in breathing, fulness of the head, or a too active pulse, gives warning of the dangers of plethora.

Scrofula. Considered as an independent disease, scrofula is not under the influence of iron; but whenever it is complicated with anæmia, and, in females, with menstrual derangements, these affections should be treated with iron as if they existed independently. The iodide of iron is thought to be peculiarly adapted to such cases, and the most eligible form for administration in phthisis.

Connected with a strumous diathesis, if not with developed scrofula, is a cachectic condition which is very common among children, and which among the poor is the immediate effect of coarse and insufficient food, and among the wealthier classes results from overfeeding or from pampering the appetite with sugared and highly seasoned food. It is distinguished by a tumid abdomen, pale face, thin limbs, a capricious appetite, and irregular and slimy dejections, often containing worms. In such cases iron is of great value, but it should be associated with vegetable tonics, and especially with bark or its alkaloids, and a saline purge or castor oil should occasionally be administered.

Constitutional Syphilis.—Few diseases induce anæmia more perfectly

than *constitutional syphilis*, and one of the greatest obstacles to the cure of the latter disease, is the impaired activity and regenerative power of the circulating fluid. This is particularly the case when mercurial medicines have been too lavishly administered, and when the ulcerated flesh and carious bones seem unable, from absolute debility, to set on foot the healing process. Cullerier, Ricord, Ratier, Behrend, and others, have used the potassio-tartrate, and other salts of iron, with advantage in those cases of primary syphilis in which the constitution is impaired, and the sore assumes a phagedenic character. Mr. Behrend believes that, even in general, the cure of the ordinary primary chancre is hastened by this treatment.¹

Cancer. Iron was resorted to in the treatment of *cancer* by Pouteau, and by Justamond, both internally and externally, and the latter reported that the ammonio-chloride of iron (*Flores Martiales*) was competent to the cure or the amendment both of open and occult cancer. This treatment was also adopted by Carmichael,² and he with several other practitioners obtained results from its administration, which, in the opinion of Dr. Walshe, entitle it strongly to notice.³ It is unnecessary to detail the experiments that have been made in the treatment of cancerous disease by means of iron. That it sometimes palliates the cancerous cachexia, and the anæmia which occurs when the system has begun to waste under the influence of open cancer, there can be no question; but there is no evidence whatever that it has ever removed or even arrested the specific heterologous formation which constitutes true cancerous disease.

Mr. G. H. Bell, of Edinburgh, first called attention to the efficacy of the muriated tincture of iron in idiopathic *erysipelas*. In 1851, when he published an account of his treatment, he stated that he had made use of it for twenty-five years without having, in a single instance, failed of success. His practice was, in mild cases, to give fifteen drops of the medicine in water every two hours, until the disease was completely removed. In severer cases the dose was twenty-five drops, "persevered in night and day, however high the fever and delirium." He used, at the same time, cotton wadding and hair powder as a local application. Dr. C. Bell confirmed the above statements by the results of his own practice, and extended the use of the remedy to traumatic *erysipelas*.⁴ Dr. Balfour found it "a certain and unfailing remedy in *erysipelas*, whether it were infantile or adult,

¹ Times and Gaz., Nov. 1856, p. 534, and p. 673.

² An Essay on the Effects of Carbonate and other preparations of Iron, upon Cancer. 2d ed., Dublin, 1809.

³ WALSHE, On Cancer, p. 197.

⁴ Month. Journ. of Med. Sci., xii. 497.

idiopathic or traumatic;"¹ and these accounts are confirmed by Mr. Hawkes.² While it is true that erysipelas is usually a self-limited disease, and that consequently the influence of treatment upon it is difficult to estimate, the results which are given above are too positive, too numerous, and extend over too long a series of years, to permit our regarding them as deceptive. This view acquires additional probability, when it is remembered that erysipelas is not the only exanthem which appears to have been cured by the preparation in question. Dr. H. S. Byrd, of Savannah, states that having employed it in erysipelas with success, he conceived that such an analogy exists between that affection and scarlet fever, as to warrant his trying the medicine in the latter disease. He accordingly prescribed it in doses of three or four drops every four hours, and in upwards of twenty cases. So persuaded was he of its value, as to declare "that he would not exchange it for all the other remedies which he had before used in scarlet fever."³ It may also be noticed, that Mr. Kerr found the persesquinitrate of iron very beneficial in several cases of urticaria, or rather of gastric dyspepsia attended with this eruption.⁴ These facts are of sufficient importance to be remembered by medical practitioners, and brought to the test of a wider experience.

As an antidote to metallic poisons, preparations of iron are employed. M. Sandras, believing that *lead*, like some other mineral poisons, is excreted by the liver, and again absorbed into the system from the intestine, proposed, by administering a syrup of the sulphate (*persulfure*, according to M. Sandras; *protosulfure*, according to M. Mialhe) of iron, to render the excreted particles insoluble, and, therefore, incapable of reabsorption.⁵ However ingenious this expedient may be, a resort to it is unnecessary while we possess the iodide of potassium.

M. Mialhe states that the hydrated proto-sulphuret, of iron,⁶ which is, itself, completely inert, decomposes *corrosive sublimate*, producing the proto-chloride of iron and the bisulphuret of mercury, both perfectly innocuous substances; and that it also neutralizes other metallic poisons, such as arsenious acid, the salts of tin, lead, bismuth, antimony, copper, silver, gold, &c. As regards *arsenic*, the most important of these poisons, in relation to the present subject, however its chemical rela-

¹ Month. Journ. of Med. Sci., xvi. 428.

² Lancet, Feb. 1856, p. 151.

³ Charleston Med. Journ., ix. 165.

⁴ Month Journ. of Med. Sci., May, 1848, p. 787.

⁵ Bull. de Thérap., xlix. 126.

⁶ This compound is prepared by "dissolving protosulphate of iron with twenty times its weight of boiled water, and precipitating the iron by means of hydrosulphite of soda or ammonia likewise dissolved in water containing no air. The precipitate is washed with similar water, and kept in glass-stoppered bottles containing distilled water."—Mialhe.

tions, when it is in a state of solution, may favor its precipitation by the sesquioxide of iron, there is strong reason to suppose that in ordinary cases of arsenical poisoning, the greater part of the poison remains undissolved in the stomach, and that the iron, in so far as it is useful, operates chiefly as a mechanical antidote, by enveloping the arsenic, and thus shielding the stomach until emetics cause its discharge.

EXTERNAL USES OF THE PREPARATIONS OF IRON.—The acid compounds of iron, and particularly the *sulphate*, with the tincture, and a watery solution of the *sesquichloride* (*perchloride*), have been employed topically in various diseases in which a local astringent action is desired.

Velpeau, making very important distinctions between erysipelas, phlebitis, diffused phlegmon, and lymphangitis, claims that in the first-named of these affections the topical application of a solution or of an ointment of *sulphate* of iron is a more efficient treatment than blisters, nitrate of silver, mercurial or simple ointment, or any other of the topical remedies which, in the course of his long experience, he had employed. He used a solution of half an ounce of the sulphate to a pint of water, and an ointment containing two drachms of the salt to an ounce of lard. The latter preparation, which appears to be preferable, should be made with the salt very finely pulverized, and applied three times a day upon the erysipelatous surface.¹ Devergie has employed an ointment made of one or two parts of sulphate of iron to thirty of lard, with great success, in obstinate cases of eczema, intertrigo, and impetigo, occurring in patients of a lymphatic constitution. In squamous affections it was useless.² When very strong, an ointment of sulphate of iron, or a solution of corresponding strength, acts slightly as a caustic upon delicate tissues.

A solution of sulphate of iron has often been used with advantage in the treatment of nasal *polypi*, to harden delicate *nipples*, and to cure *fissures* of these organs. It acts still better as a corrective of excessive and depraved mucous secretions, such as chronic gleet and leucorrhœa, and gives strength to the relaxed membrane. A solution of the sesquichloride (*perchloride*) of iron has also been used in such cases, and with especial benefit in repressing fungous granulations, as from ingrown toe-nail, &c. Its energy exceeds that of the sulphate. In a case of gleet treated by injections of the former substance, fatal inflammation of the bladder ensued; in two other cases urethral hemorrhage

¹ Bull. de Thérap., xlviii. 15.

² Ibid., xlvii. 553.

was produced in the same manner.¹ Even in *hemorrhage* from slight wounds, or from the surface of an integument, the sulphate of iron is sometimes an efficient application. It is less so, however, than a *watery solution of the perchloride*, which has been found successful, after the failure of other hæmostatics, in epistaxis, in hemorrhage from leech-bites, from the jaw after the extraction of teeth, from cancerous ulcers of the neck and of the uterus,² and to arrest uterine hemorrhage during or subsequent to abortion.³ Maisonneuve used it to arrest hemorrhage during the excision of a fungous tumor of the dura mater.⁴

Although the idea of treating aneurisms by injecting them with an astringent substance had been proposed by Monteggia in 1813, and by Leroy d'Etiolles in 1844,⁵ yet to Dr. Brainard, of Chicago, belongs the credit of having first coagulated the blood in a vascular tumor by injecting it with a solution of a salt of iron. In November, 1851, he successfully treated an erectile tumor of the orbit by injecting it, by means of an infiltrating canula, with a solution of eight grains of *lactate* of iron to a drachm of distilled water.⁶ In January, 1853, M. Deslongchamps used a watery solution of the sesquichloride of iron in the same manner, and with complete success, in the treatment of a varicose aneurism of the forehead,⁷ and similar instances of its use were reported by Serre (d'Alais), Valette, of Lyons, and by Lawrence, Cock, and Hilton, of Guy's Hospital.⁸ M. Pravaz also illustrated the remarkable coagulating power of this substance by his experiments upon animals. But whether it is that the method is not uniform in its effects, or whether it has been imprudently applied, its use occasionally is followed by severe inflammation and suppuration in the neighborhood of the aneurismal sac, or by ulceration of the latter. A case of popliteal aneurism, in which M. Lenoir employed this method, terminated fatally with symptoms of phlebitis.⁹ In other cases, again, the operation was purely negative in its effects, and a cure of the disease was afterwards obtained by the ligature. M. Jobert is of opinion that it should be reserved for traumatic aneurisms of recent formation, and free from inflammation, and that it is dangerous when the aneurismal sac is inflamed, or is likely to be unsound.¹⁰ M. Malgaigne, in a report to the Academy of Medicine, states that out of eleven operations, in which this method had

¹ Bull. de Thérap., lii. 236.

² RÉMILLY, *ibid.*, xlv. 512.

³ SCHREIER, Phila. Med. Exam., Dec. 1855, p. 725.

⁴ Brit. and For. Med.-Chir. Rev., xviii. 261.

⁵ Bull. de Thérap., xlv. 465.

⁶ Lancet, Aug. 20, 1853.

⁷ Bull. de Thérap., xlv. 304.

⁸ Times and Gaz., March, 1857, p. 286.

⁹ Bull. de Thérap., xlv. 369.

¹⁰ *Ibid.*, xlv. 447.

been used, "there had been four deaths, five serious accidents, and two cures;" and he concludes by saying that "no prudent surgeon would venture to expose his patient to so disastrous a mode of treatment."¹ M. Bonjean has proposed the addition of ergotin to the solution of perchloride of iron, as a means of lessening its irritating qualities and of augmenting its styptic power;² and M. Leelerc has cured vascular nævus by applying to the cutis (previously denuded, or not, of its epidermis) compresses soaked with a solution of the perchloride. By this means a gradual but complete removal of the tumor is obtained.³

M. Burin de Buisson has attempted to show that a "neutral perchloride of iron" is quite as powerful in coagulating blood as the acid salt, and that, indeed, the latter, by carbonizing the blood, impedes the ultimate absorption of the clot, and even eauterizes the internal surface of the pouch. M. B. states that the salt recommended by him has no such action, and may be taken internally, without danger, in doses of from fifteen to thirty grains, properly diluted.⁴ On trial, however, this preparation is alleged by others to be as mischievous as the acid compound.⁵

Several physicians of Paris have used the solution of the perchloride of iron with marked success in the treatment of ophthalmia with enlargement of the bloodvessels upon the surface of the cornea; a form of disease notoriously rebellious to ordinary modes of treatment.⁶

ADMINISTRATION.—*Powder of iron* may be given in the dose of *two or three grains*, and from that to six grains, three times a day mixed with syrup or molasses, or simply diffused in water. It may also be prescribed in the pilular form with sugar, or in pastilles of chocolate, which are allowed to dissolve in the mouth.

Iron filings, scales of iron, and the *magnetic oxide*, are given in about the same dose. All of the preceding, and all of the insoluble preparations of iron, should be administered immediately before, during, or after meals. The *hydrated sesquioxide*, which is used only as an antidote to arsenic, should be given without stint.

Rust of iron and the *sub-carbonate of iron* may be prescribed in doses of from five to thirty grains. The medium dose of *Vallet's ferruginous mass* is five grains three times a day; but in the beginning the dose should not exceed two or three grains. All of the foregoing preparations ought to be associated with bitter vegetable tonics in the begin-

¹ Bull. de l'Acad., xix. 101, 104.

² Bull. de Thérap., xlviii. 362.

³ Ibid., xlix. 518.

⁴ Ibid., xlv. 263.

⁵ Ibid., xlv. 366.

⁶ FOLLIN, Arch. Gén., 5ème sér., vii. 424; BROCA, and others, Annuaire de Thérap., 1857, p. 172.

ning, at least, of their administration, whenever the digestive process is conducted feebly and laboriously.

The *compound mixture* and the *compound pills of iron*, supposed to have a peculiar adaptation to cases in which menstrual irregularity, anæmia, and a tuberculous cachexia are present, may be administered, the former in the dose of one or two fluidounces, and the latter in that of two or three pills, several times a day.

Sulphate of iron, after having been deprived of its water of crystallization, may be given in pilular form, in the dose of one or two grains. The crystallized salt may be administered in a sweetened liquid, and in the dose of from one to five grains. As a lotion for cutaneous eruptions, and as an injection for the cure of mucous discharges, a solution containing from five to fifteen grains to the ounce, may be employed; but in erysipelas, as already stated, Velpeau used a solution of half an ounce of the sulphate dissolved in a pint of water.

Solution of nitrate of iron may be given in doses of from five to thirty drops three times a day, diluted with a sufficient quantity of water.

Phosphate of iron may be prescribed in pill or powder and in doses of from five to ten grains.

Tartrate of iron and potassa is preferably given in solution, and in doses of from five to ten grains three times a day, when the stomach is empty.

Wine of iron, which is a solution of the last named salt, in sherry wine (*Lond. Ph.*), may be taken in the dose of from a tablespoonful to a wineglassful two or three times a day.

Tartrate of iron and ammonia, and *citrate of iron*, which are not preferable to the tartrate of iron and potassa, may be given in the same dose as that salt.

Citrate of iron is given in pills, in pastilles, or in syrup, and in doses of from five to ten grains.

Citrate of iron and quinia is prescribed in pilular form, or in syrup, and in doses of from one to five grains before or after each meal.

Tincture of the acetate of iron. "The dose is from min. xxx to fʒj. Dr. Percival was in the habit of administering it in asses' milk; it may be given thus, or dropped in water or in cod-liver oil."

Lactate of iron may be prescribed in the dose of from five to forty grains.

Valerianate of iron is stated to have been given in one grain doses.

Tincture of chloride of iron or *muriated tincture of iron* is administered in doses of from ten to twenty or thirty minims appropriately diluted with water. The ethereal tincture of Bestuscheff is given in doses of

from ten to eighty drops, two or three times a day, upon sugar or in sweetened aromatic water.

Solution of iodide of iron may be prescribed in doses of from twenty to fifty drops in water or other diluent. To protect the teeth from discoloration, the mouth should be rinsed after each dose.

Prussian blue. The daily dose of this preparation is stated by Trousseau at from thirty grains to five drachms. This and similar statements of other physicians favor the opinion that the medicine is inert.

Bromide of iron. According to Neligan its dose is from three to eight grains twice a day.

CINCHONA.—PERUVIAN BARK.

DESCRIPTION.—“The bark of different species of Cinchona.” The word *kina*, in the Peruvian language, signifies bark, and its reduplicate *kinkina*, the native name of the medicine, means the bark of barks. The systematic designation cinchona was applied to the genus of trees producing it, by Linnæus, in 1742, in honor of the Spanish Countess Cinchon, who was one of the first to test the febrifuge virtues of the bark. Cinchona trees are found only in South America, in the higher regions of the Andes, where they form a belt of forests extending in a southwest direction from latitude 10° N. to 19° S., and in breadth about forty or fifty miles. They belong to the natural family *Cinchonaceæ*, and to the *Pentandria monogynia* of Linnæus. They are trees or tall shrubs. The leaves are opposite, upon short petioles, with plain margins; the flowers are white or of a purplish rose-color, terminal, arranged in corymbose panicles, and very fragrant. The bark is the only portion of the tree that is employed in medicine.

In commerce Peruvian bark occurs in the form of quills, or flat pieces of various sizes and thickness, and of a brownish-gray, yellow, or red color, of a bitter and nauseous taste, and, when powdered, of a somewhat aromatic odor. The size and color of the pieces of bark depend chiefly upon the age of the tree from which it is procured; the finer and more delicate quills being furnished by the smaller branches, and the flat pieces by the larger limbs, or by the trunk of the tree. The former belong to the pale commercial varieties of cinchona, consist of the cellular layer of the bark and contain chiefly *cinchonia*, while the latter are formed mainly by the fibrous layer, the cellular having been removed by scraping. It is in the fibrous layer

that *quinia* chiefly resides, and hence the barks treated in the manner referred to, contain but a small proportion of cinchonia. This is the case with calisaya bark, the most esteemed of all the varieties.

Water extracts the virtues of Peruvian bark partially, but alcohol more completely; the addition of sulphuric or muriatic acid to either menstruum renders the solution more perfect.

The officinal barks are these:—

1. *Pale Barks*.—This variety is in cylindric, rolled pieces or quills. The epidermis is of a grayish color; the true bark is moderately fibrous, more or less brownish or yellowish, and its powder is of a grayish-fawn color. It is astringent rather than bitter, and contains more cinchonia than quinia. The Loxa and Lima barks belong to this variety.

2. *Yellow Barks*.—The pieces are larger than those of the pale barks, and are either flat or rolled. They are often destitute of epidermis, and the proper bark has a fibrous texture. Yellow bark is very bitter, and is almost free from astringency. When powdered, it is of a brownish-yellow color, inclining to orange. It is very rich in quinia. The calisaya bark is of this variety.

3. *Red Barks*.—Barks of this variety are intermediate between the other two. The pieces are either flat or rolled; the epidermis is never detached. The proper bark is fibrous, and of a brownish-red color, and both bitter and astringent in taste. It contains both quinia and cinchonia. The powder is of a bright brownish-red color. This variety includes the brown and red barks of Carthagena and Lima.

Besides the above, various other cinchona barks enter into commerce which are not officinal, some of which, like certain of the Carthagena barks, contain little or no quinia, and but a small proportion of cinchonia. Of the barks recently introduced from New Granada and Venezuela, some contain a very large amount of quinia. Such is the calisaya bark of Santa Fe. The supply from this new source is likely for a long time to meet the demand, and is indeed to be chiefly depended upon, especially since it is now ascertained that most of the barks which were formerly employed in the treatment of malarial affections, contain more cinchonia than quinia.

ORGANIC PRINCIPLES.—The constituents of Peruvian bark are very numerous, but the principal are *quinia*, *cinchonia*, *quinoidia*, and *quinidia*, which exist in combination with kinic acid, or with a red coloring matter which has all the properties of tannin.

Quinia is a whitish, flocculent substance, inodorous, but extremely bitter and very fusible. It is slightly soluble in boiling water, and is even less so in cold water; on the other hand, it readily dissolves in

hot alcohol or ether. It is also soluble in the volatile and fixed oils, and with the acids forms crystallizable salts.

Cinchonia is white, crystallizable, inodorous, and bitter, although slightly less so than quinia, unless in solution, and is but slightly fusible. It dissolves in 2500 times its weight of cold water, but is more soluble in hot water. It is less soluble than quinia in alcohol, and very slightly so in ether, or in the volatile or fixed oils. Like quinia, it forms crystallizable salts with the acids. It is distinguished from quinia by its action with ammonia when dissolved in chlorinated water. Under these circumstances it gives a white precipitate, while that of quinia is green.

Quinoidia is an amorphous, brownish, resiniform substance, of very bitter taste. It is procured by exposing the above-mentioned alkaloids, or bark itself, to the action of the sun, or is obtained from the mother waters of sulphate of quinia, by the addition of an alkaline carbonate. It is uncrystallizable, as are also the salts which it forms with acids. It is sometimes sold under the name of *precipitated extract of bark*.

Quinidia is an alkaloid isomeric with quinia, and, like that substance, has a bitter taste, but in a less intense degree. Its crystals are unlike those of quinia, in being hard and shining. It is very soluble in alcohol, but is less so in ether, and in boiling water it dissolves very slightly. Its salts are more soluble than those of quinia. According to some authorities, two different substances have been described as quinidia. One of them, to which the name of quinidia should be restricted, is isomeric with quinia, and forms similar salts; the other, called *cinchonidia*, is isomeric with cinchonia, and its salts are analogous with the salts of this alkaloid.

Preparations of Cinchona.

Quiniæ Sulphas.—SULPHATE OF QUINIA.

According to the U. S. Pharmacopœia, this salt is procured by the following process. The bark employed is coarsely powdered, and boiled in water containing one-third part of muriatic acid, by means of which a soluble muriate of quinia is produced. On the addition of lime, the muriatic acid unites with this latter, and quinia is precipitated along with a portion of lime and of coloring matter. The precipitate is then washed in boiling alcohol to dissolve the quinia, and separate it from the impurities with which it is associated. The alcoholic solution of quinia is next evaporated until it forms a brown viscid mass, which is dissolved in boiling distilled water acidulated with sulphuric acid. By these means a sulphate, or more properly, a disulphate of quinia is

formed, which crystallizes when the solution cools. Carbonate of lime, in the form of unpurified bone-black, is, however, previously added, to neutralize the free sulphuric acid and decolorize the solution. The latter purpose is perfected by a second crystallization.

The salt procured in the manner above described is, according to some authorities, a neutral sulphate, composed of one equivalent of the acid and one of the base, while others regard it as a disulphate, containing one equivalent of the former and two of the latter. It is a crystalline salt, its crystals being very delicate, white, shining, flexible, and acicular. It is inodorous, but intensely bitter. On exposure to the air, the crystals effloresce slightly. At a temperature of 212° F., and with moderate friction, they become phosphorescent; at a somewhat higher temperature they coalesce, forming a tenacious mass, and at a red heat are decomposed without residue. Sulphate of quinia dissolves readily in thirty parts of hot, and in 740 parts of cold water, giving the solution in the former case a bluish tinge. It is perfectly soluble in alcohol, and but very slightly so in sulphuric ether.

Bisulphate of Quinia is produced by adding sulphuric acid to a solution of the neutral salt, and evaporating the liquor. It crystallizes in four-sided prisms, and is much more soluble in water than the sulphate. In practice it is usually prepared extemporaneously by the addition of sulphuric acid to a mixture of the sulphate with water, until the solution of the latter salt is complete; or, after each dose of the sulphate, a draught of water slightly acidulated with sulphuric or other acid is administered.

Several other salts of quinia have been procured, and are occasionally used in medicine, but they possess no advantage over the sulphate. The principal are these: the *muriate*, *nitrate*, *acetate*, *citrate*, *tartrate*, *phosphate*, *tannate*, *hydrocyanate*, *ferrocyanate*, *lactate*, and *valerianate*.

Crude Quinia.

In the process above given for making sulphate of quinia, it is stated that by treating the powdered bark successively with muriatic acid, lime, and alcohol, a viscid mass is obtained. This is impure quinia. It is a soft solid of resinous aspect, and consists of a mixture of quinia, cinchonia, and the other alkaloids of bark, with more or less coloring and extractive matters. It has but little bitterness unless it is dissolved by the addition of an acid, and on this account is sometimes preferred for administration to females and children. The average dose is about the same as that of sulphate of quinia, and it may be given suspended in water, but better in the form of pill, or cut into small pieces, and mixed with honey or preserves.

Quinoidia.

Quinoidia, quinoidin, or amorphous quinia, is the substance obtained by precipitation, by means of an alkaline carbonate, from the mother liquor left after the preparation of sulphate of quinia. It is formed by variable proportions of quinia, cinchonia, and the extractive matters of bark. It is a dark, amorphous substance, which is not soluble in water; but when finely divided it has an acrid and slightly bitter taste.

Sulphate of Quinidia.

This salt is distinguishable from sulphate of quinia by its greater solubility in water and alcohol; its composition is the same as that of the latter preparation.

Sulphate of Cinchonia.

There are two sulphates of cinchonia, as of quinia, but the neutral sulphate or disulphate alone is a crystalline solid. It contains about 84 per cent. of cinchonia. It is more soluble than the sulphate of quinia, requiring only 54 parts of cold and a less proportion of hot water for its solution. It is soluble in alcohol, and is rather less bitter than the sulphate of quinia.

Decoctum Cinchonæ Flavæ.—DECOCTION OF YELLOW BARK.

An ounce of bruised yellow bark is boiled for ten minutes in a covered vessel, and the liquor strained while hot. It is usually recommended to add lemon-juice or a little sulphuric or muriatic acid to the menstruum before boiling. In appropriate cases wine may be used for this purpose instead of water, and in either case a little bruised orange-peel improves the flavor of the decoction.

Decoctum Cinchonæ Rubræ.—DECOCTION OF RED BARK.

This decoction is prepared in the same manner as that of yellow bark.

Infusum Cinchonæ Flavæ.—INFUSION OF YELLOW BARK.

An ounce of bruised yellow bark is infused in a pint of boiling water, macerated for two hours in a covered vessel, and strained.

"This Infusion may also be prepared from the same quantity of Yellow Bark, in coarse powder, in the following manner. Having moistened the Bark thoroughly with Water, introduce it into a percolator, press it slightly, and pour water upon its surface so as to keep it covered. So long as the liquid passes turbid, return it into the apparatus; then allow the filtration to continue until a pint of clear infusion is obtained."

Infusum Cinchonæ Rubræ.—INFUSION OF RED BARK.

This infusion is prepared in the same manner as the previous one. In both cases wine may be used as a menstruum instead of water.

Infusum Cinchonæ Compositum.—COMPOUND INFUSION OF PERUVIAN BARK.

“Take of Red Bark, in powder, *an ounce*; Aromatic Sulphuric Acid *a fluidrachm*; Water *a pint*. Macerate for twelve hours, occasionally shaking, and strain.

“The Infusion may also be prepared from the same quantity of Red Bark, in coarse powder, by the process of displacement, in the manner directed for the Infusion of Yellow Bark, *a fluidrachm* of Aromatic Sulphuric Acid being added to the water with which the Bark is moistened.”

Extractum Cinchonæ Flavæ.—EXTRACT OF YELLOW BARK.

“Take of Yellow Bark, in coarse powder, *a pound*; Alcohol *four pints*; Water *a sufficient quantity*. Macerate the Yellow Bark with the Alcohol for four days; then filter by means of a percolator, and, when the liquid ceases to pass, pour gradually upon the Bark sufficient Water to keep its surface covered. When the filtered tincture measures four pints, set it aside, and proceed with the filtration until six pints of infusion are obtained. Distil off the alcohol from the tincture, and evaporate the infusion, till the liquids respectively are brought to the consistence of thin honey; then mix them, and evaporate so as to form an extract.”

Extractum Cinchonæ Rubræ.—EXTRACT OF RED BARK.

This is prepared from the red bark in the same manner as extract of yellow bark.

A *Fluid Extract* of Bark is directed by the London Pharmacopœia to be prepared with water and sufficient alcohol to prevent its decomposition. Another, prepared, according to the method of Mr. Taylor, of Philadelphia, by means of alcohol, is reduced by evaporation, and then united with sugar. The latter contains the virtues of the bark more completely than the former.

Tinctura Cinchonæ.—TINCTURE OF PERUVIAN BARK.

“Take of Yellow Bark, in powder, *six ounces*; Diluted Alcohol *two pints*. Macerate for fourteen days, express, and filter through paper.

“This Tincture may also be prepared by thoroughly moistening the Bark with Diluted Alcohol, allowing it to stand for forty-eight hours, then transferring it to a percolator, and gradually pouring upon it Diluted Alcohol until two pints of filtered liquor are obtained.”

Tinctura Cinchona Composita.—COMPOUND TINCTURE OF PERUVIAN BARK; HUXHAM'S TINCTURE OF BARK.

“Take of Red Bark, in powder, *two ounces*; Orange Peel, bruised, *an ounce and a half*; Virginia Snakeroot, bruised, *three drachms*; Saffron,

cut, Red Saunders, rasped, each a *drachm*; Diluted Alcohol *twenty fluid-ounces*. Macerate for fourteen days, express, and filter through paper.

"Compound Tincture of Peruvian Bark may be prepared from the same dry materials, by beating them well together, moistening them thoroughly with diluted alcohol, allowing the mixture to stand for forty-eight hours, then transferring it to a percolator, and gradually pouring upon it diluted alcohol until twenty fluidounces of filtered liquor are obtained."

HISTORY.—The introduction of cinchona into European practice as a medicine was singularly slow, and embarrassed by great impediments. Its virtues appear to have been familiar to the Spaniards in Peru, after the conquest of that country, and as early as the year 1600, but it acquired no settled reputation for nearly a century later. It is even stated by Condamine that in 1735, the natives of the province of Loxa, whence the best varieties of the bark were procured, attached but little value to it as a medicine. After the lapse of still another century, Humboldt made a similar remark, and even quite recently, in 1848, Delondre found the Indians who were engaged in gathering the bark careless about taking it, although they were nearly all deeply affected with the malarial cachexia. This indifference, however, is readily understood, when it is remembered that the medicine possesses no prophylactic powers against intermittent fever, and it is not inconsistent with the fact stated by other travellers that the bark is highly esteemed by those of the natives who suffer from periodical fever at some distance from the sources of its infection.

Peruvian bark appears to have been first carried to Europe in 1632. But according to Villarobel, it had been seven years in the possession of the Spaniards before any trial was made of its virtues. A certain ecclesiastic of Alcala is said to have been the first person in Spain to whom it was administered. This was in the year 1639. It however became more generally known through the Count of Cinchon, Viceroy of Peru, whose wife had been cured by it of intermittent fever. On his return to Europe about 1640, he carried with him a quantity of the medicine, and distributed it to the poor. Owing to the circumstance which led to its importation it was called the "Countess' powder." Yet the indifference or the hostility of the Spanish physicians towards it, as a new remedy, prevented its general use, nor was so great a boon to suffering humanity accepted by the reluctant Faculty until the public sentiment in its favor was determined by an authoritative decision of the head of the Catholic Church. In 1643, a Spanish Jesuit, Juan de Logo, was ordered by Pope Innocent X. to

examine the bark, and, on the favorable report of his Holiness' chief physician, it was declared to be not only innocent but most salutary. In 1649 or 1650, Brunacci, the Provincial of the Jesuits, brought a large quantity of it with him from America, and, a great council of the order being held at the time, a good opportunity occurred of sending it to all parts of Europe by the brethren on their return to their homes. From these circumstances it acquired the name of *Jesuits' bark or powder*.

The history of the introduction of Peruvian bark into medical practice forms a sad commentary upon the blindness and perversity of human nature. Religious and scholastic prejudices conspired to reject and condemn one of the most valuable discoveries recorded in the history of medicine. Protestant bigotry refused to admit that a powder introduced by the Jesuits, and called after them, could possibly possess any salutary virtues, and the Galenical schools would not believe that a medicine could cure unless its operation were explicable according to their established dogmas. These fanatics even went so far as to attribute the ordinary constitutional results of malarial poisoning to the new remedy, as the vulgar of the present day are accustomed to do.

For many years the bark was sold at a very high price, and this prevented its virtues from being completely known, or a proper method adopted for its administration. On this account many physicians abandoned it as an uncertain remedy for intermittent fever, and also because it did not afford security against a return of the paroxysms. In England it appears to have been used pretty extensively after the year 1660. Yet for twenty years subsequently to this date, its virtues were imperfectly acknowledged. In 1662, Guy Patin declared that cinchona does not cure intermittent fever, and that he had abandoned its use. Even in 1682, Sydenham speaks of it without enthusiasm, although not doubtingly. Twenty years later still, Torti felt himself obliged to reiterate the assertion that it is a most innocent remedy. It is not, he exclaims indignantly, either venomous or narcotic; it does not inspissate the humors, nor cause jaundice, dropsy, or apoplexy, nor aggravate the fevers it is alleged to cure; it is not that sortilegious and diabolical medicine which the scribblers and physicians of the 17th century represented it to be; and he calls Morton and Sydenham to witness with himself that it was never known to injure any one.¹ The real appreciation of the value of cinchona bark as a remedy for intermittent fever, must be attributed to an English-

¹ Therapeutic Specialis, Lettere a Muratori.

man, Talbor by name. He was an apothecary of Cambridge, but removed to London about the year 1670. He professed to have a very successful method of administering the bark, but he kept it a secret. The jealousy excited in the College of Physicians by his success obliged him to seek the protection of the Court, and the King actually issued a mandate to the College forbidding them to molest or disturb him in his practice. After having become famous in England, he was sent for to France, where he was so fortunate as to cure Condé, Colbert, and the Dauphin. Louis XIV. purchased his secret for 2000 louis d'or, and an annual pension of 2000 livres, besides conferring upon him a patent of nobility and a ten years' monopoly of his remedy. For a time the bark was sold at exorbitant prices, a single dose costing a louis d'or. Thus, as Sir George Baker remarks, in recording the principal events in this narrative:¹ "Had it not been for the casual experience of an uncivilized people, it might never have been discovered that there existed in the stores of nature a specific febrifuge. Had not the influence of a great religious society, unconnected with the practice of physic, counteracted prevailing prejudices, at an early period, this medicine, though brought into Europe, might have long remained in obscurity, unknown, and useless. And lastly, had not physicians been taught by a man whom they, both abroad and at home, vilified as an ignorant empiric, we might at this day have had a powerful instrument in our hands, without knowing how to use it in the most effectual manner."

In the middle of the last century Peruvian bark began to be employed in continued fevers of a low type, and acquired the character of a standard remedy in these affections upon the recommendation of Huxham, Pringle, Fordyce, and Cullen. Haygarth, Fothergill, and Heberden, employed it in gout and rheumatism, towards the close of the same century.

The discovery of the active principles of cinchona imperfectly made, in 1803, by Duncan, of Edinburgh, was perfected by Pelletier and Caventou, in 1820, as far as regards quinia and cinchonina. In 1833, Henry and Delondre announced the existence of quinidia, whose true characters were more fully determined by M. Pasture, in 1852. The introduction of these salts into practice, which dates from 1820 and 1821, is due to MM. Double, Magendie, Chomel, and Villermé, in France, and to Drs. Elliotson, Dickson, and Barker, in England. By whom or when it was introduced into the United States, it is impossible to say, since the leading medical journals from 1825 to 1830,

¹ Med. Trans. of the College of Physicians in London, iii. 173.

contain little respecting the medicine, that is not borrowed from European sources.

Within a few years the range of medical experiment with quinia, and the other alkaloids and constituents of cinchona has been greatly extended by the labors of Jacquot, Monneret, Riliet and Barthez, and especially by M. Briquet, whose work on the curative action of cinchona and its preparations, is a monument of singular industry and well directed zeal.¹

ACTION. On Animals.—The experiments which were at first performed to determine the medical properties of cinchona, consisted in applying a decoction of this substance to the various solids and liquids of the economy. The tannin of the decoction produced its usual physical result, coagulation of albumen, and this was tortured into various shapes in support of many different hypotheses. But no practical result was obtained. We must come down to a period subsequent to that of the discovery of quinia, for more precise notions on the subject. According to experiments performed in 1829, Desiderio inferred that sulphate of quinia acts upon rabbits as a stimulant, and that its effects are heightened by alcohol and opium, but diminished by cherry-laurel water, digitalis, and blood-letting. But Giacomini, who repeated these experiments in 1840, came to a directly opposite conclusion. In truth the effects observed by both experimenters were the same; but Giacomini, regarding the secondary phenomena alone, perceived in them the effects of sedation, while Desiderio, finding venesection an efficient remedy for the primary symptoms, concluded them to be the result of stimulation.² The symptoms actually witnessed were these: General muscular debility, and a condition resembling intoxication; in fact they closely resembled those which are produced in man by very large doses of quinia. In the experiments performed by Magendie, and also by Mélicr,³ sulphate of quinia given to dogs in half drachm doses, acted poisonously, and was rejected from the stomach unless the œsophagus was tied. When this precaution was taken, however, death occurred in the course of about twenty-four hours, and was preceded by the following symptoms: vomiting, or, if that was prevented, retching, agitation, trembling, and an unsteady gait, with a drooping and feeble aspect. The pupils were dilated, the pulse frequent (120), and coma, with muscular spasms, and labored, stertorous breathing, preceded death. On dissection, the lungs were

¹ *Traité Thérapeutique du Quinquina et de ses préparations*, 2ème éd. Paris, 1855.

² *Académie des Sciences*, Oct. 1829; *Révue Méd.*, xcvi. 368.

³ *Mém. de l'Acad.*, x. 722.

found engorged with blood, the vessels of the brain, and also of the stomach, were congested, and the blood contained in them was liquid, or else formed a soft, gelatinous clot, and the serum was turbid and discolored. Similar effects were observed, by Dr. Baldwin, of Florida, in some experiments performed by him.¹

Comparative Action on Animals and Man.—We shall, in imitation of those who have investigated this subject experimentally, describe the effects of sulphate of quinia and other salts of cinchona upon the different organs, beginning with circulatory apparatus.

On the Circulation. The experiments on animals performed by Briquet led him to the following conclusions: The sulphate of quinia injected into the veins in sufficient quantity suspends at once the action of the heart, causing death by syncope and destruction of the heart's contractility; and when this result does not ensue, the movements of the heart continue for several days to be slow and feeble.²

In small doses cinchona and its preparations increase the frequency of the pulse, but in large doses appear to act sedatively upon the circulation. Thus Giacomini took from forty to fifty grains of sulphate of quinia during the night, and found that his pulse fell as much as twelve beats in a minute. This result was furnished by a series of experiments which lasted forty-seven days. But no account seems to have been taken of the natural subsidence of the pulse in the night time. The experiments of Favier, if accurate, are more to the purpose. Under the influence of about twelve grains a day his pulse fell from the normal rate to 57 and then to 50 beats a minute, and when four times this dose was taken the pulse fell to 45 and 40, and became thready. Dr. Mendenhall, of Cincinnati, on different occasions took two, five, ten, and twenty doses of sulphate of quinia, but the last named dose alone had any sensible effect upon the pulse, increasing its frequency slightly.³ In those diseases to which it is particularly applicable, viz., the periodical fevers, sulphate of quinia undoubtedly reduces the frequency of the pulse, partly by its direct sedative action, but partly, also, it may be presumed, by neutralizing or removing the cause of vascular excitement. In many cases the pulsations fall so far below the normal rate, as to leave no doubt that they are affected by the medicine. M. Legroux found this sedative influence strikingly evident in acute rheumatism, the pulse falling daily by as much as ten

¹ Am. Journ. of Med. Sci., April, 1847.

² Dr. Baldwin, of Montgomery, Ala., in his experiments upon dogs, found the frequency of the pulse *increased*. It is probable that the alarm of the animals more than counteracted the sedative action of the quinia upon the heart.

³ Am. Journ. of Med. Sci., July, 1846, p. 79.

beats, and at the same time becoming smaller, and sometimes intermittent.¹ Drs. Hunt and Mackie, of N. O., reached similar results in experiments performed by them on convalescents from various diseases in 1845.² M. Briquet, who cites numerous observers in proof of the sedative action of quinia, has also performed many experiments of his own, and appears to be warranted in drawing the following conclusions: 1. Sulphate of quinia *in large doses* moderates the frequency of the pulse, and sustains its influence for several days after the administration of the medicine has ceased. 2. This action is proportioned to the existing frequency of the pulse, and the largeness of the dose of the medicine, but is never observed when less than fifteen grains are administered at once. 3. An intercurrent inflammation may neutralize this sedative operation. 4. The pulse is diminished in force as well as frequency. 5. The dose required to produce this effect occasions such a disturbance of the system as to render its administration improper, unless the disease, by its duration, severity, or the dangers it involves, exposes the patient to a still greater risk.

The influence of the salts of cinchona *on the blood itself* is variously appreciated by different observers. Bonora and Arvedi state that when sulphate of quinia is administered to horses in large doses, the blood drawn loses the power of coagulating which it previously possessed.³ So Mélier, Monneret, and Magendie, have observed that when sulphate of quinia is given to animals, or is taken by man in poisonous doses, it appears to lessen the coagulability of the blood. M. Legroux, in the few analyses of the blood made by him in cases of acute articular rheumatism treated by quinia, found the proportion of fibrin diminished, and that of the red globules increased. Briquet, on the other hand, maintains that, whether the medicine is received into the stomach, or injected into the veins, it equally augments the proportion of fibrin in the blood, and diminished that of the red globules. These different, and indeed opposite results, do not at present appear to be reconcilable.

On the Nervous System. When the salts of cinchona, in large doses, are administered *to animals* by the stomach or otherwise, they derange, enfeeble, and finally extinguish nervous action, after having at first occasioned a certain degree of excitement, attributable perhaps to the local irritation of the salt employed. Afterwards the animal staggers, becomes agitated, and sometimes convulsed, and then assumes a dull, inanimate expression, and subsides into a state of apparent debility

¹ Journ. de Méd., iii. 109.

² N. O. Méd. and Surg. Journ., and Bulletin of Med. Sci., iv. 19.

³ MÉLIER, loc. cit.

and torpor, with impaired vision, and widely dilated pupils. In all such experiments, the only lesion found after death is increased vascularity of the membranes of the brain.

When five or six grains of sulphate of quinia are taken by an adult man at a single dose, or two or three times that quantity in the course of twelve hours, some heaviness and confusion of thought are usually experienced; there is occasionally headache, and frequently buzzing in the ears, vertigo, and unsteadiness of gait. The noises in the ears are various, and are compared to the ringing of bells, the striking of a clock, the rushing, roaring sound of water or of steam. When the doses are larger, or are repeated more frequently, a sense of fulness, tension, and pulsation is experienced in the head; the face becomes suffused and animated, the eye is bright, epistaxis sometimes occurs, the patient is restless and agitated, and complains of muscular twitching in the limbs. These phenomena are of several hours' duration, and are succeeded by some exhaustion, and an inclination to sleep, with slight torpor and muscular debility. If as much as thirty grains are given daily, in divided doses, for several successive days, there may be observed very great depression, apathy, and somnolence, a very unsteady gait, hardness of hearing, dimness of vision, and dilatation of the pupils; the general sensibility is very obtuse, the muscular movements are feeble, and the limbs tremulous. If, finally, the dose has been excessive, complete loss of consciousness may occur, sight and hearing may entirely fail, the skin may lose its sensibility, and the limbs their power of motion.

Some of these symptoms may be more particularly noticed. *Headache* seldom becomes so severe as to imply danger; indeed, in some cases, as in typhoid fever, this symptom has appeared to be relieved by quinia. The *deafness*, although sometimes very great, and even complete, is alleged never to be permanent; but this rule is not absolute, as will hereafter be shown, at least in regard to excessive or long continued doses of the medicine. *Tinnitus aurium* usually subsides in a few days, at furthest. The *eye* is morbidly sensitive, and experiences a feeling of tension, vision is subsequently clouded, objects appear double or unnaturally small, and finally, very large doses may produce blindness. In that case the pupils are largely dilated. This amaurosis seldom lasts longer than a day or two, but Briquet mentions a case in which it did not cease for a month. *Giddiness* and *buzzing in the ears* are among the most usual effects of the medicine, but the confusion of sight and faintness which accompany them cease as soon as the patient lies down. They are apt, however, to recur for several days whenever the erect posture is assumed. In the higher de-

grees of cinchonism, the patient sometimes *reels* as if intoxicated, and presents the appearance characteristic of the invasion of low fevers. In a few cases of nervous and excitable persons, *delirium* has been observed, sometimes of a gay or noisy description, like the excitement produced by alcohol,¹ but less frequently it accompanies a dreamy, dull, and listless condition. In a few instances, also, *convulsions* have occurred, either when the dose was too large, or when it was given to a person affected with cerebral disease. Finally, when an overdose is taken, as in the cases cited below, a state of debility may ensue which gradually deepens into *collapse*.

On the Respiratory Organs. In Mélier's experiments upon animals poisoned with sulphate of quinia, their lungs were found to be engorged, but M. Briquet insists that this condition resulted from the protracted agony of the animals, already exhausted by other experiments, and that when death takes place from the sulphate of quinia alone, the lungs are quite as often pale as engorged. The same want of uniformity exists in the pulmonary lesions found in man in fatal cases of poisoning by this salt. That the lungs are, however, embarrassed in their functions, but probably through the nervous more than the circulatory system, is proved by observation. It is not unusual for persons under the use of large doses of the medicine to complain of tightness and oppression at the præcordium; at the same time the face grows pale and wears a look of distress. Sometimes, indeed, there is severe dyspnœa, and a sibilant rhonchus is heard in the lungs. Yet there is no reason to believe that this interference with respiration predisposes the lungs to become engorged or inflamed.

On the Digestive Organs. Peruvian bark and its preparations have always ranked among the most efficient of stomachic medicines. Its salts have less energy in this respect than the bark itself; yet they are generally employed, and sometimes with evident advantage, to strengthen the digestion and quicken the appetite. In large doses, however, they manifestly derange the stomach, causing a sense of oppression and even pain in this organ; at the same time there may be dryness and bitterness of the mouth, and a foul and pasty tongue, which sometimes, on the other hand, becomes dry and brown in the centre, while its edges are red and shining. Not unfrequently, also, nausea and vomiting occur when the doses are too often repeated; and

¹ A very interesting case is related by Dr. Baldwin of a man affected with quotidian remittent fever, who took about 36 grains of sulphate of quinia at a dose. The effect was exhilarating. The patient was in a fine humor, talking incessantly, and laughing, and insisting on the reality of events which were purely imaginary.—*Am. Journ. of Med. Sci.*, April, 1847, p. 308.

if the administration is still persisted in, all the symptoms of gastric inflammation may arise. Analogous effects are produced in the intestinal canal. Small doses have a decided tendency to produce constipation, while large quantities very generally occasion diarrhœa. There are persons, however, who experience colic with diarrhœa even from very small doses of sulphate of quinia. In such cases the administration of the medicine should be guarded by opium.

It has been asserted that bark influences the size of the spleen, causing it to contract by a direct agency when it is enlarged. This action is more probably of a secondary nature. The bark, by curing the disease which maintains the spleen in an enlarged condition, induces the contraction of the organ in the same way as it favors the restoration of all the impaired functions. Certain experiments of Valleix upon cases of ague with enlarged spleen, appear to show that quinia has no direct influence in lessening the size of this organ.¹ But these results do not coincide perfectly with those obtained by Dr. Smith, of Madras, and which the reader will find in a subsequent portion of this article.

On the Genito-urinary Organs. The elimination of the salts of cinchona with the urine exposes these organs to irritation. If the urinary tract be anywhere the seat of disease, it is apt to be aggravated by these medicines. This effect is frequently observed in gonorrhœa. Sometimes, independently of such a cause, the patient is affected with irritation about the neck of the bladder, with hæmaturia, or with retention of urine.²

Some persons have attributed to quinia an emmenagogue operation. Possibly when large doses of the medicine are given to females the irritation produced by it in the bladder may be propagated to the uterus, occasioning good or evil effects according to the existing condition of that organ. But evidence upon this point is still wanting.

Local Action.—When a salt of quinia is applied to the denuded cutis it occasions severe burning and smarting pain, and sometimes forms a superficial eschar. M. Trousseau refers to two cases in which an eschar of half a line in thickness was produced. M. Briquet relates that a female patient of his for whom he prescribed baths to be taken at intervals of several days, each of them containing about half an ounce of sulphate of quinia, experienced a prickling and smarting sensation in the skin during the bath, and after leaving it her body was covered with red spots which were succeeded by an eruption of acute lichen.

Poisonous Effects. The earlier historians of cinchona did not fail to

¹ Lancet, Sept. 4th, 1847.

² DASSI, Bull. de Thérap., xv. 248.

notice that ill effects occasionally arise from its use, such as gastric derangement, colic, diarrhœa, headache, restlessness, sleeplessness, and deafness; but these symptoms were always temporary, and seldom reached so high a degree as to excite alarm. But after the discovery of quinia which contained in a small bulk the principal powers of the medicine, cases occurred which were distinguished by very alarming symptoms, such as delirium, coma, blindness, deafness, gastralgia, epileptiform convulsions, aphonia, paralysis, congestion of the lungs, and hæmaturia. Trousseau speaks of a young woman who was delirious for a whole day after taking twenty grains of sulphate of quinia. In another case, that of a male, forty-six grains rendered the patient blind, deaf, and delirious, and so giddy as to be unable to walk. He also vomited continually. Giacomini reports the case of a man of middle age who took by mistake about three drachms of sulphate of quinia at a single dose. He gradually became giddy and feeble and then insensible. Nine hours after taking the medicine he lay motionless and pallid, the fingers were bluish and cold, and the whole surface cool, the respiration slow and suspirious, the pulse regular, but slow and hardly perceptible, the pupil widely dilated, the sight and hearing almost extinct, and the voice extremely feeble; the thirst was great, the tongue pale and moist, and the breath cold. The patient could not leave his bed until the fifth day.¹ A similar case is narrated by Dr. Baldwin in which sixty-eight grains were taken in the course of about twenty hours.²

But the evidences of the poisonous properties of this drug are also furnished by cases in which it proved fatal to life. Four such cases are collected by M. Mélier.³ In one of these the patient was affected with delirium and coma, and died on the second day. Guersant has given an account of a physician and his wife, both of whom were poisoned by this preparation, the former fatally, after taking nearly five ounces of sulphate of quinia within the space of eight or nine days. The symptoms were such as have been detailed in the case of Giacomini.⁴ Dr. Baldwin has reported the case of a child, six years of age, who died from taking eight grains of this salt, in two doses, with an interval of three hours between them, and with symptoms like those already described.⁵ Whenever, in such cases, the body has been examined after death, the same lesions have been found as upon

¹ Mémoires de l'Acad. de Méd., x. 731.

² Amer. Journ. of Med. Sci., April, 1847, p. 295.

³ Mémoires de l'Acad. de Méd., x. 733.

⁴ Dict. de Méd. 2ème éd., xxvi. 569.

⁵ Am. Journ. of Med. Sci., April, 1847, p. 293.

dissection of animals destroyed by the same cause, viz., congestion of the lungs and brain, and to some degree also of the stomach.

A fatal effect, it has just been stated, may follow the administration of comparatively small quantities of quinia. Such doses, when continued, have occasionally produced toxical, but less serious consequences. Dr. Van Buren saw partial loss of hearing result from taking two grain doses of quinia for a period of two weeks, and a case of amblyopia of three weeks' duration, and quite intractable, follow the use of four grain doses every four hours for a week.¹

But in some cases, it should be borne in mind, enormous doses have been taken without fatal or even alarming consequences. In the case of the lady related by Guersant, and referred to above, about ten drachms were used within the space of a few hours. Banquier states that one of his patients took seventy-two grains of sulphate of quinia by mistake, and without hurt; and Tomasi di Spineto asserts that ninety grains may be given several times a day without danger.² "A medical friend in Alabama," says Dr. Dickson, "assures us that he had administered thirty grains of the solution of quinine every hour for seventeen successive hours; and we have heard authentically of a Western physician, who emptied into the stomach of a patient laboring under bilious remittent, an ounce bottle of sulphate of quinine in one night. From thirty to fifty grains are now spoken of as not unfamiliar doses, and even one hundred grains are occasionally given at once, and, we are assured, both with safety and striking success."³ Dr. Drake mentions a man at Memphis, Tenn., who took eighty grains of quinia at a single dose, and another at Montgomery, Ala., who consumed an ounce in the course of three days, and recovered. At Plaquemine, La., an old lady used ten grains every two hours, until an ounce had been taken. No bad effects followed.⁴ It must not be forgotten that sulphate of quinia is often largely adulterated. This fact may help to explain the innocuousness of the medicine in some of the many cases, resembling the above, which are said to be of frequent occurrence in the western and southern portions of the United States.

MODE OF ACTION OF CINCHONA AND ITS SALTS.—That the active principles of bark may undergo absorption by the sound skin, can hardly be doubted, when it is remembered how often intermittent fever has been cured by bark jackets, baths, &c. The results immediately to be noticed, merely prove that the salts of cinchona are not

¹ N. Y. Journ. of Med., vi. 81.

² MITSCHERLICH, Lehrbuch, i. 295.

³ South. Journ. of Med. and Pharm., i. 9.

⁴ Diseases of the Interior Valley of North America, i. 777.

so absorbed in sufficient quantity to be detected in the urine. Martin Solon concluded, from a number of experiments instituted by himself, that sulphate of quinia is not absorbed by the skin, even when denuded of its epidermis.¹ But other writers, and among them Mitscherlich,² state unequivocally that it is absorbed in the latter case. While the cuticle remains unbroken it is probable that a comparatively trifling degree of absorption takes place. The carefully conducted experiments referred to by Briquet, and those performed by himself, show that however applied to the sound skin, sulphate of quinia cannot be detected in the urine. It is, however, absorbed by the denuded cutis in small quantities. If applied in substance it causes severe pain, as already stated; but dissolved in water, or incorporated with simple ointment, the application is less severe.

This salt is readily absorbed by the mucous membranes, and is found substantially in the blood, which dissolves it much more readily than water. It has been detected also in the saliva, the bronchial mucus, the tears, and milk, and in the serum of dropsical effusions. It is eliminated very slightly with the perspiration or the fæces. On the other hand, one-half of the quantity taken may be recovered from the urine. A portion, also, is presumed to be decomposed. According to Dietl, the urine of healthy persons becomes more rapidly charged with quinia than that of diseased persons, and the urine of the young than that of the old. In disease, also, he states that it frequently does not show its presence in the urinary secretion for several days; and, on the other hand, that it continues to be eliminated for some days after its use has been suspended.³ According to Ranke, the sulphate of quinia diminishes the quantity of uric acid in the urine.⁴

The experiments of M. Briquet led him to conclude that the constitutional influence of a full dose of sulphate of quinia (15 grains) begins to be manifested within a quarter of an hour after it is taken, and that of a dose of six grains, in about an hour; also, that sensible effects are rarely observed when the dose is less than four grains. Hence, it is evident that whenever a prompt and decided effect is required, the dose must be large. The salts of the other alkaloids of cinchona are subject to the same law. The duration of the symptoms to which they give rise is proportioned to their dose. When six or eight grains of sulphate of quinia are taken at once, their sensible action upon the nervous system ceases in the course of two or three hours, while that of fifteen grains lasts from three to five hours. When

¹ Bull. de Thérap., xxvii. 466.

² Op. cit., i. 294.

³ CANSTAT's Jahresbericht., 1854, p. 154.

⁴ Times and Gaz., May, 1857, p. 537.

twelve or fifteen grains are taken in divided doses, during as many hours, their influence is sustained for eight or ten hours after the last dose; and when the doses are augmented, the effects are proportionately prolonged. If, however, decidedly morbid symptoms arise, such as giddiness, deafness, &c., they may be of much greater duration.

Circumstances modifying the Operation of the Salts of Quinia.—*Age.* According to M. Baudeloeque, the functional disturbance caused by these preparations is less decided in children than in adults. He states that even when as much as thirty grains a day of sulphate of quinia are given to children, it occasions neither vomiting, headache, delirium, staggering, colic, nor diarrhoea, and only a slight degree of buzzing in the ears, on the other hand, it displays unusual activity in persons advanced in life, prostrating the strength, disturbing the mind, occasioning ataxic symptoms, deranging the bowels, and irritating the urinary passages.

Sex. In females absorption of the salts of quinia, as shown by their appearance in the urine, is more active than in men, and in accordance with this fact, their influence upon the nervous system is proportionately greater. Especially is the delirium produced by large doses of these medicines most frequent in women. It is estimated by M. Briquet, that the dose proper for them is one-fifth less than may be given to men.

M. Briquet infers from his experiments and observations that depletion favors the operation of sulphate of quinia, while diffusible stimulants, such as wine and coffee, diminish and counteract it. Such is also the conclusion of Giacomini from his own experiments.¹

Loss of blood augments the sedation from large doses of the medicine partly by its own immediate influence and partly by promoting the absorption of the salt. The action of the salts of morphia when they are associated with those of quinia, appears to justify the practice which so generally prevails in the malarious regions of the United States, of employing this combination. M. Briquet is of opinion, also, that opium mitigates the cerebral excitement which is a primary effect of quinia, and, on the other hand, augments the sedation which characterizes the secondary effects of the latter, and hence that a full dose of opium renders a corresponding quantity of quinia less perturbative and more efficient. This combination is very important in acute rheumatism as well as in periodical fevers.

Nature of the Action of Sulphate of Quinia.—M. Briquet infers from his own experiments, and from the evidence of other observers, that

¹ Annuaire de Thérap., 1843, p. 175, &c.

sulphate of quinia "is not a stimulant, but a cooling and calming remedy."¹ This judgment is inadmissible if applied to small doses of the medicine, but appears to be correct as regards large doses, particularly if the word sedative be substituted for the terms employed by M. Briquet. Such is, indeed, the fact with respect to other stimulant agents, such as opium and alcohol. Like these, also, quinia may with propriety be regarded as a sedative of morbid excitability in diseases to which it is appropriate; for, in many affections, as typhus fever and delirium tremens, the excitement and derangement of function which characterize them are the result of debility, and subside when the nervous system is strengthened by stimulants. But quinia is not merely a stimulant, it exerts a sustained action which diffusible stimulants cannot imitate, and, for a much longer period than they do, sustains the system against its internal tendencies to morbid action; and also, unlike them, it does not leave behind it a degree of debility proportioned to the excitation which preceded its administration. It is, in other words, a tonic stimulant when given in doses of medium size, as it is a sedative when administered in large doses. In smaller doses still it is purely tonic, and its mode of action would seem to be like that of bitter tonics generally, and to depend chiefly upon a local impression made upon the mucous membrane of the stomach. Apart from that influence of large doses which approaches or even reaches a toxic degree, we cannot find anything in the operation of cinchona which entitles it to be classed with sedative medicines. When administered in large doses, like opium or alcohol similarly given, it directly depresses the activity of the nervous and circulatory systems, and, in addition appears to exert some influence, both upon the constitution and the vitality of the blood, since it is only upon such a supposition that the sanguineous effusions and congestions which it sometimes causes can be explained. Conceding such a change to exist, it must be added to the causes of sedation already admitted.

The inventor of homœopathy imagined cinchona to be capable of generating a febrile paroxysm resembling that of intermittent fever, and, indeed, this notion was a fundamental principle of his system. Here and there in the annals of medicine may be found a case in which a similar effect is attributed to quinine; and, we know that poisonous doses of the medicine induce a condition resembling somewhat

¹ It may be mentioned that this view of the action of quinia was long ago contended for by Dr. J. W. Monett, of Washington, Miss. (*Am. Journ. of Med. Sci.*, Nov. 1833, p. 33.) This writer then maintained that quinine "contains the febrifuge essence of bark uncombined and without any tonic property whatever." He further declared that it is a febrifuge because it is contra-stimulant.

the cold stage of a malignant intermittent fever. But of the former cases it is sufficient to say that quinia, like other local irritants and tonics, sometimes occasions a transient excitement of the circulation and of the nervous system; and of the latter as well as of these, it may be remarked that quinia in no conceivable dose or combination, ever generated that which is essential to the disease in question, a periodical succession of similar paroxysms.

Action of the Salts of Cinchona compared.—According to M. Briquet, *cinchonia* affects the nervous system in the same manner as quinia, but is one-third feebler. But the experiments of MM. Bouchardat, Delondre and Girault,¹ have led to a somewhat different conclusion. They proved that sulphate of cinchonia is more poisonous to frogs and dogs than sulphate of quinia. They also showed a difference between the two salts in their mode of action upon man. The former does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it produces more constantly than the sulphate of quinia, and in smaller doses, a peculiar pain in the anterior part of the head, with a remarkable sense of oppression there. These phenomena are produced by doses of from twelve to fifteen grains of sulphate of cinchonia, which also occasions, more frequently than the other salt, pains about the præcordium, subsultus tendinum, and general debility and faintness.

Quinidia has the same effects and in the same degree as quinia; and *quinoidia* does not differ sensibly from these, except that it is more apt to irritate the digestive tube, producing nausea, a burning epigastric pain, thirst, colic, and diarrhoea. A derangement of the same sort was very frequently produced by *powdered cinchona* while it was still customary to administer this drug, and when it was taken for a long time together, serious symptoms arose from the accumulation of its ligneous particles in the bowels.²

¹ Supplément à l'Annuaire de Thérap. pour 1856, p. 153.

² The following summary of the action of cinchona and its salts is abridged from M. Briquet, and will perhaps afford the reader, in a brief and connected view, a more distinct idea of this important subject than is conveyed in the text.

Three or four grains of the sulphate of quinia, or an equivalent portion of cinchona, increases the activity of the circulatory, respiratory, and nutritive functions. An agreeable warmth is felt at the epigastrium, and extending thence to the neighboring organs; the pulse rises, perspiration occurs, and all the functions, including those of the brain, are rendered more active. These effects are more distinctly produced by bark than by its alkaloids. If the administration of bark is continued, the blood becomes richer and nutrition more active.

Larger doses, consisting of or representing twelve grains of sulphate of quinia, give rise to a different order of phenomena. Within the first two hours a marked cerebral excitement occurs, with tensive and throbbing headache, morbid sensibility of the eyes to light, buzzing and ringing in the ears, vertigo, unsteadiness of gait, and some

REMEDIAL EMPLOYMENT. *As a Prophylactic against Malarious Diseases.*—It has long been believed that cinchona not only cures periodical fevers, but that it also is able to prevent their development in the system. Indeed, as we are informed by Dr. Bryson,¹ there is a standing rule in the British navy, when seamen are sent ashore in tropical malarious regions, that a dose of bark in wine shall be administered to each man, as a prophylactic medicine. Owing partly to a neglect of this rule, or a repugnance to taking the nauseous dose, and partly to the inadequate mode of its administration, confidence was lost in the efficacy of the prescription. But of late years a different system has prevailed. Amorphous quinia, dissolved in wine, has been substituted for the bark, and it has been given not only on the day of exposure, but also for fourteen days after the exposure has ceased. Various testimony is cited by Dr. B. to prove that on the most pestilential of all naval stations, the western coast of Africa, the crews of vessels can be kept nearly free from malarial fevers, chiefly by means of the measure which has been described. These statements have been fully confirmed by the subsequent experience of Mr. Hayne upon the same station.² Without questioning the accuracy of the result, we are nevertheless inclined to the opinion that it depends rather upon the immediate

palpitation of the heart, muscular quivering, a sense of internal agitation, and general excitement; the face is flushed, the skin is warmer, and the pulse and respiration are more frequent. If the dose is excessive, or too frequently repeated, these symptoms may be followed by delirium or convulsions.

This excitement is one of the ill effects of the medicine in large doses, but it can be restrained within due limits by prolonging the intervals between the doses. After it has passed, the sedative influence on the nervous system becomes manifest. Muscular movements are performed languidly, or there is a complete inability to execute them; the sight and hearing grow dull, taste and smell are impaired, aphonia results from paralysis of the vocal muscles, and dyspnoea from impaired energy of those which move the chest. The heart and pulse become feeble, and the temperature of the body falls.

The local action of cinchona and its preparations on the stomach is that of a stimulant within the physiological limits, but of an irritant beyond the latter. Hence, if the gastric mucous membrane is already inflamed, these medicines, and especially the salts, in large doses, may occasion violent reaction, pain, and even ulceration and gangrene. Effects similar in kind may be produced in the urinary passages by the absorption and elimination of quinia. Finally, the prolonged use of quinia may cause a diminution of the red globules and an increase in the proportion of fibrin and water in the blood.

From these considerations it follows that the salts of quinia, in large doses, are irritants in their local, and nervous sedatives (*stupéfiants*) in their general operation, somewhat like ether, chloroform, and even prussic acid. In those preparations of bark, on the other hand, which contain the largest amount of extractive matters, the tonic and astringent properties predominate.

¹ Times and Gaz., Jan. 1854, p. 6.

² Ibid., March, 1855, p. 281.

neutralization of the febrile poison by the quinia than upon the resistance which this latter enables the system to oppose to the entrance or the influence of the miasm.

Periodical Diseases.—Intermittent Fevers. It is unnecessary to adduce any proofs of the virtues of cinchona as a remedy for these affections. The medicine is a specific for them, and is universally recognized as such. But the most perfect instruments fail of accomplishing their purpose if they are not used aright, and therefore it is important that we should know what are the conditions under which cinchona best displays its marvellous powers of cure.

1. *Preparatory Treatment.* Certain vague notions in regard to the pathology of intermittent fevers, and the importance of removing splenic and hepatic congestions, and restoring the balance of the circulation,¹ led to the use of depletory and evacuant measures, which, whatever else they may have done, debilitated and prostrated the patient. "Depletions," according to Dr. Copland, "are almost indispensable preliminaries to the quinine or bark, especially in the complicated or congestive forms; for without them it will either not be retained on the stomach, or, if retained, will convert congestions, or slight forms of inflammatory irritation, to active inflammation, or to structural change." This precept appears to have been fully acted upon by the greater number of East Indian practitioners,² who also coupled with it an extremely feeble method of administering quinia. This consisted of giving doses of two or three grains every three or four hours during the apyrexia, a method wholly inadequate to the purpose in view. But even in the region where the preparatory treatment above described was most in vogue, some physicians have been found to abandon it in favor of a more efficient plan. Dr. Morehead denounces it,³ and urges the administration of quinia at the very earliest intermission, in three doses of from four to six grains each, every other hour, immediately before the expected paroxysm. Still more striking evidence in support of the method of resorting early to the antiperiodic will be adduced in the sequel. Undoubtedly, gastric and congestive derangements often complicate intermittent fever; but they are usually under the immediate dependence of the malarial element,

¹ As a specimen of this vague style of reasoning the following may be quoted: "Other remedial agents should always be conjoined with the quinine, and often precede its employment, to effect the restoration of a sufficient degree of equilibrium between the different forms of the automatic nervous force to enable it to consume, by cellular action, in a safe and efficient manner, the excess of the chemical force."—*Quinine in Fever*, by J. Casselberry.

² MARTIN, *Influence of Tropical Climates*, p. 194.

³ *Diseases of India*, i. 42.

and when this is counteracted by the specific medicine they spontaneously subside.

2. *Bark and Quinine compared.* Since the introduction of the alkaloids of cinchona into practice it has become almost universally the custom to prefer them to bark itself.¹ There is some reason to doubt whether this substitution is always advantageous. As we have seen, bark contains other febrifuge elements besides quinia, and also certain tonic and astringent principles. MM. Trousseau and Pidoux, assuming that a drachm of bark contains about two grains of quinia, say that an intermittent fever ought to be as curable by means of four grains of quinia as by two drachms of bark. But this is not the fact. On the contrary, twelve and even fifteen grains of sulphate of quinia are necessary to produce the curative effect of two drachms of bark. The latter, it is true, contains a certain proportion of cinchonia, but not enough in itself to account for the alleged differences in its effects. These may, perhaps, depend, in part, upon the gradual manner in which the febrifuge principles of the bark are extracted from it in the digestive organs, and partly also upon the tonic and astringent elements with which they are associated. Undoubtedly the use of bark is more economical than that of quinia, and should, even on that ground, be preferred where expense is to be avoided, as in hospitals and among the poor. The objection founded upon its taste and bulk is not of much importance, except when the patient is unusually fastidious. If it be said that powdered bark is very liable to adulteration, it may be answered, not more so than the salts of quinia and cinchonia, which are constantly the subjects of fraudulent manoeuvres. Cinchona is an anti-periodic and also a tonic, but quinia, which is eminently anti-periodic is but slightly tonic, and only when given in small doses. In chronic periodical diseases, then, where a tonic and corroborant influence is required in addition to a febrifuge operation, quinia may become incompetent to the cure, which will be readily accomplished by cinchona, either alone or associated with preparations of iron. Then the re-constituent influence of the latter medicine joined to the anti-periodic and tonic powers of the former, triumphs over both elements of the disease; the digestion improves, the blood becomes more

¹ In 1823 sulphate of quinia was first used in England by Dr. Elliotson. Speaking of the rapidity with which violent cases of intermittent fever were cured by very small doses of the new drug, he wittily quoted these lines from Virgil's *Battle of the Bees* :—

“ Hæc certamina tanta,
Pulveris exequi jacta, compressa quiescunt.”

Med. Chir. Trans., xii. 563.

abundant, and richer in red globules, the complexion regains its natural hue, and the nutritive function its original activity and strength.

The distinction here insisted upon, and which is of the highest practical importance, is not a novel one, although it is too often lost sight of in practice. Even in 1828, Dr. Vulpes, of Naples, claimed for bark a superiority in all "putrid fevers," while he regarded quinia as specially applicable to periodical affections and especially intermittent fever and neuralgia.¹

With these remarks on the superiority of bark over its alkaloids in certain cases, we proceed to consider their uses in periodical fevers; adding, only, that whenever a certain dose of quinia is spoken of, a similar dose of cinchona may be substituted, or powdered bark in the proportion of about one drachm to six grains of either alkaloid, regard being had to the efficacy of the bark and not to the amount of quinia or cinchona it contains.

3. *Quantity required to be given.* In the early use of cinchona small doses of it were administered. Torti prescribed no more than an ounce of bark to prevent the paroxysms of malignant intermittent fever, and for simple cases the dose was a drachm.² But Cullen declared that the smallest quantity he had found to cure an intermittent was at least six drachms during the apyrexia, and he thought it safer to give an ounce or more. He adds, however, that but few stomachs will bear more than two drachms at once.³ It is probable that the medicine was not of the same quality in the two cases. Until within a few years, and before the powers of bark had been fully investigated, it was customary, except in the Southwestern States of this country, to give six or eight grains of sulphate of quinia in divided doses during the intermission. Although this method was generally successful in the end, at least in curing the simple forms of intermittent fever, it rarely produced its effect until several paroxysms had elapsed. But later experience has shown that the disease can be abruptly arrested by a single dose of from five to eight grains in simple intermittents, and of fifteen or from that to thirty grains, in congestive intermittents, or by this quantity taken in two or three doses. In this manner a costly medicine is economized, and the system saved from the repeated shocks of the disease. As already intimated, large doses of quinia were given at an early period in the United States. In 1826 Dr. Perrine, of Natchez, published an account of several cases of intermittent fever, in one of which he administered eight grains of the sulphate every

¹ Archives Générales, xvii. 135. For further comparison between cinchona and quinia, see Jacquot, Arch. Gén., 4ème sér., vi. 78.

² Op. cit., lib. iii. cap. iii.

³ Works, i. 641.

three hours, until sixty-four grains had been taken.¹ About the same time, it may be mentioned, Chomel stated that he had frequently given as much as sixty grains of quinia in a day for *tic douloureux*.² But these were unusual instances.

4. *Time of Administration.* In the beginning, the method recommended by Torti was the one generally adopted. It consisted in administering a full dose of bark immediately before the paroxysm, not with the hope of preventing it, but in order to operate more certainly upon the succeeding fit. This haste is wholly unnecessary, except in certain malignant cases approaching the type of remittent fever. The bark given in the early part of the apyrexia, is always in time to moderate or prevent the coming paroxysm, but if exhibited immediately before a paroxysm, it is sure to aggravate it, however favorably it may affect the one that follows. Sydenham, looking upon the fit as an effort of nature to throw off some noxious matter in the blood, gave the powder immediately after the fit, and at regular intervals during the intermission. According to him, it was better "to imbue the blood with the drug moderately, gradually, and at long intervals before the fits, than to attempt, by a single blow, to cut short the paroxysm at its accession."³ But having arrested the paroxysm, the medicine was suspended, and resumed at the end of the first and also of the second week. Home concluded, from the experiments which he instituted in regard to this subject, 1. That bark is more efficacious in stopping the paroxysms of intermittents, and curing the disease, when given at the end of a fit, or at forty hours distance from the succeeding fit, than two, three, or four hours before it. 2. That bark given a few hours before the fit seems to add to its severity. 3. That fifteen or sixteen hours are a sufficient time to enable the bark to operate. But, asks this author, does it not require at least two or three days before all its good effects are produced?⁴ Cullen refers to a custom, which prevailed in London in his time, of giving a large dose of bark immediately at the approach of the fit, and of this he says, he is satisfied it "is the most proper practice."⁵ This method, which has been very generally followed by English,⁶ and partially by American authorities,⁷ has not the support of those who have made the largest comparative trials of the different methods. The latter have adopted more or less completely the methods of Torti, Sydenham, Morton, and Home. Thus, Bretonneau

¹ Philad. Med. Journ., xiii. 39.

² Archives Gén., xvii. 136.

³ Works (Syd. Soc. ed.), ii. 13 and 18.

⁴ Clinical Experiments. Lond., 1783.

⁶ Mat. Med., ii. 97.

⁶ PEREIRA, Mat. Med. (3d Am. ed.), ii. 686.

⁷ CHAPMAN, EBERLE.

says that a single dose (fifteen grains) of quinia, sufficient to occasion marked physiological phenomena, or at most two such doses given upon successive days, affords protection against the paroxysms of simple intermittent for a week.¹ These doses he administers as far as possible from the coming paroxysm. In order to prevent relapses, he directs the same dose to be given at the end of five days, and afterwards of eight days for a month. M. Trousseau has modified this plan as follows: Fifteen grains of quinia are given immediately after the paroxysm; the same dose is repeated after an interval, at first of one, then of two, then of three, and then of four days. In cases of long standing, the medicine should still be continued at intervals of five days, and afterwards of ten, fifteen, and twenty days. An advantage belonging to this method over that of giving more moderate but daily doses of the medicine for a length of time, is that it avoids the danger inherent in the latter course, of deranging the stomach and of creating an artificial intermittence, or of rendering the system tolerant of the medicine, and at last insusceptible to its influence.² Dr. Graves was perhaps the first to call attention to this subject; for after a comparative trial of several methods of administering quinia in a case of obstinate quartan ague, he came to the conclusion that it is best "to give no quinia until a well-marked fit, or shadow of a fit, occurs, and then at once to use the medicine in large doses;" for, as he remarks, if the medicine is continued throughout the apyretic interval, the system becomes accustomed to its impression, and is less powerfully affected than when it is taken only at such times as the derangement which it is adapted to remedy is about to occur.³

M. Briquet, who prefers administering quinia in divided doses, arrives at the following conclusions relative to the proper time for its administration. When the last dose is given at the approach of the fit, its influence upon the latter is seldom manifested; and when this dose is given from four to eight hours in advance, the fit is moderated, or prevented in one-half of the cases; but in some of the remainder the succeeding fit is prevented, although no more of the medicine may have been taken. When a period of twelve hours intervenes between the last dose of the medicine and the hour of the attack, this latter generally fails to occur, and the succeeding paroxysm always. When the medicine is given from fifteen to thirty hours before the time of the fit, it is uniformly successful in preventing the attack, and this former period is the one which M. Briquet adopted as

¹ Journ. de Méd., iii. (1845), p. 66.

² TROUSSEAU and PIDOUX, *Thérap.*, 5ème éd., ii. 350.

³ Dub. Quart. Journ., Feb. 1846, p. 72.

the best of all between the last dose of the medicine and the hour of the paroxysm. As the cases treated by M. Briquet included every type of intermittent fever, from quotidian to quartan, and were all more or less marked by the malarial cachexia, and had enlargement of the spleen, they offered a sufficient and conclusive test of the plan of treatment applied to them.¹ It is of great importance to notice here that the anti-febrile influence of quinia does not coincide with its physiological operation, either in time or in degree. A dose of six grains, for example, is sufficient to prevent the occurrence of a febrile paroxysm fifteen hours afterwards, and yet its direct and sensible action upon the system may be imperceptible, or, if decided, may entirely have passed away before the period of the next paroxysm. This fact, which modern observation and experiment have rendered positive, refutes completely the notion that the anti-periodic operation of bark is explicable by its sedative influence upon the nervous system, and leaves us again without other resource than to adopt the hypothesis that quinia eliminates a morbid poison from the system, or to take refuge under the convenient cloak for ignorance, the recognition of a specific virtue, *virtutem febrifugam*, in bark.

The method which is here advocated is pursued by the best authorities in all parts of the world. Thus, Bretonneau says: "It has been ascertained that the prolonged administration of repeated doses, amounting in all to several effective doses of the medicine, is perfectly nugatory. A quartan ague, which resisted two ounces of bark given in the course of a fortnight, has been known to yield to two drachms of the same bark in a single dose. So wine does not display its intoxicating power when taken in small portions at a time."² Dr. Austin Flint found that the most effectual method of treating intermittents was to give twenty or thirty grains of quinia at once, or, in divided doses, at short intervals, at the early part of the intermission.³ Dr. Upshur, of Virginia, followed the same plan, although he was not prevented from administering quinia even in the hot stage. He then found the pulse to decline under large doses of the medicine.⁴ In the same way Dr. Murchison, formerly in the Bengal service, administered twenty grains of sulphate of quinia at a single dose during the sweating stage. In three-fifths of the cases no further treatment was required.⁵

Malignant Intermittent Fever. Although the proper administration

¹ Op. cit., p. 599.

² Journ. de Méd., iii. 66.

³ Am. Journ. of Med. Sci., October, 1841, p. 277.

⁴ Phil. Med. Exam., March, 1847, p. 143.

⁵ Edinb. Med. and Surg. Journ., January and April, 1855.

of quinia in this form of disease may, in great part, be inferred from the preceding remarks, it will not perhaps be amiss to devote a few words specially to this subject. The necessity of employing very large doses for its cure was fully recognized by Torti, who gave a quantity of bark equivalent to about thirty grains of quinia during the apyrexia. The experience of recent times, and especially that of the army surgeons in Algeria, fully sustains the propriety of the treatment. In these diseases it may be necessary to employ depletion, evacuations, and revulsives; but such means are of little avail without the addition of quinia. Nor should the violence of the symptoms deter from its administration. Whatever else it is advisable to do, this is essential; and often, if it does not relieve from the necessity of resorting to other measures, it renders them more efficient. It must, however, be administered in large doses—such as twenty or thirty grains—during the apyrexia. If the stomach rejects it, it may be introduced by the rectum; or if the bowels themselves are irritable, or if diarrhoea prevents the medicine from being retained, it may be associated with black drop or some other opiate. The largest doses of quinia are required in the algid forms of intermittent fever. Maillot relates a case of this affection in which forty grains of sulphate of quinia, with a drachm of sulphuric ether, were given by the mouth, and sixty grains of the salt by the rectum, within an hour. The following day reaction had commenced, but was not fully established, and the prescription was repeated. In another day the patient was out of danger. It is remarkable that in such cases, treated in the manner described, the reaction that ensues is not violent, and indeed is probably much less so than if it had been accomplished by the unaided struggles of nature.

Remittent Fever. Sir James Annesley, and most other East Indian practitioners, insist upon the necessity of preceding the use of bark by evacuant and depletory measures. Mr. Martin informs us that in former times, when bark alone was relied upon for the cure of all tropical fevers, the results were horrible, and he reiterates the necessity of employing depletory means as introductory to the use of the medicine, which, he adds, should be given “in large and often repeated doses.”¹ Without doubt, many cases will bear such treatment, and it may not often be productive of serious injury, but its necessity is so far from being demonstrated, that there is rather ground for believing that it only postpones injuriously the use of really curative means. As has been clearly shown by Dr. Boling, “cases originally violent almost

¹ Influence of Tropical Climates, p. 166.

invariably die while *preparing* for the quinine, and those of moderate severity become worse under this *preparation*.¹ Nor is the existence of a topical inflammation or congestion a contraindication to this treatment. Now that it is certain that large doses of quinia are directly sedative in their action, we can in part explain why, under their influence, the local symptoms of the attack, instead of being aggravated, are actually mitigated. But we must also remember, what has before been insisted upon, that the local disturbances are subordinate to the miasmatic poisoning, and that they subside in proportion as it is counteracted or its cause is eliminated. At the same time, it would be uncandid not to admit that when no contraindication exists, the moderate use of evacuant remedies (emeto-cathartics) renders the operation of quinia more certain, and in a less dose than would otherwise be required.

In regard to the proper time for the administration of the medicine, the remission is to be preferred, and from twelve to sixteen grains should be given in one, two, or three doses, with an hour's interval between them. But if the paroxysm has already commenced, and the symptoms are very urgent, as in the congestive forms of the disease, no time should be lost in prescribing the antidote in double the quantities just named, and at shorter or longer intervals, according to the duration of the remission. After control has been obtained over one paroxysm, the medicine may be exhibited in doses of one-half the original quantity, or even less, for two or three periodical revolutions. This method, which originated in the United States, and has the sanction of the most eminent of American physicians, has been put into practice by physicians of other countries, and especially by the French army surgeons in Africa, and the English practitioners in India. Mr. Morehead, in his work already quoted,² advises to give four or five grains of quinia four or five times during the remission, and in the inflammatory form to increase each dose to five or eight grains. In the cerebral form, he remarks, "It matters not what the nature of the cerebral symptoms may be, the treatment of the febrile remission with adequate doses of quinia is a ruling indication." Other physicians, in the same country, particularly Drs. Corbyn, Mackinnon, Mactier, Murchison, and Hare, gave scruple doses of quinia in the remission with a success far superior to that of their colleagues who followed the older method.

Enlargement of the Spleen and Dropsy. Piorry, as is well known, entertains the singular notion that periodical fevers depend upon en-

¹ Am. Journ. of Med. Sci., July, 1846, p. 42.

² Disease in India, i. 181, 195.

largement of the *spleen* as their organic cause, and that a cure of the former is effected by a contraction of the latter under the influence of quinia. It is unnecessary to combat so gratuitous a hypothesis, but the fact is still an interesting one, that in many recent cases of intermittent fever, with enlarged spleen, this organ actually contracts under the primary and often the immediate influence of the medicine. This has been shown by Dr. Smith, of the Madras Medical Service. Out of seventeen experiments with large doses of quinia, in cases of enlarged spleen, a greater or less diminution of the organ occurred in eleven.¹

The *dropsy* following ague is sometimes cured by preparations of bark. Three such cases, which resisted diuretics and purgatives, are reported by Dassit.² It is not improbable that these cures were secondary to a reduction in the size of the spleen.

Intermittent Non-miasmatic Affections. It is in neuralgic affections of this type (which will be considered hereafter) that quinia displays the greatest power. But it is also efficacious in other intermittent affections. Giannini relates the singular case of an intermittent fever caused by the introduction of a catheter. Numerous paroxysms occurred regularly until bark was administered. Two years afterwards, on the catheter being introduced, it produced, as on the first occasion, pain, hemorrhage, and a chill, followed by fever and sweating, and a similar paroxysm returned eight times, at irregular intervals. The attack ceased under quinia as before. Three years later, the same accidents and the same mode of cure were renewed, and subsequently still, another attack, more obstinate than the preceding took place.³

M. Fallot reports a singular case of *conjunctivitis*, in which the inflammatory symptoms occurred daily in the afternoon, and resisted all treatment until quinia was administered, and then the attack ceased abruptly.⁴ It by no means follows, however, that all intermittent or paroxysmal affections, or even those which present the phenomena of intermittent fever, are curable by quinia. Sometimes such intermittence has its origin in a local irritation, and in that case the removal of the cause is the only effectual remedy. Many cases of intestinal worms belong to this category. Paroxysmal fevers depending upon hepatic disease have been pointed out by Portal as peculiarly intractable to the anti-periodic treatment.

Other Alkaloids of Bark in the Treatment of Periodical Fevers. When first used by Chomel the sulphate of *cinchonia* was less efficient than

¹ Month. Journ. of Med. Sci., Oct. 1851, p. 359. ² Bull. de Thérap., xvi. 112.

³ Cuvier, Thèse de Concours (1838), p. 23.

⁴ Journ. Complémentaire, xxxiv. 262.

it afterwards proved in the hands of Dr. Bardsley, who, in 1830, published nine examples of its complete success.¹ M. Hudellot, of Bourg (Ain), treated 509 cases of intermittent fever with sulphate of cinchonia, found it equally effectual with quinia in the same doses, both as a curative and as a prophylactic medicine.² It should be given in doses about one-third greater than those of the sulphate of quinia. Dr. Cullen has partially reported the results of the use of sulphate of *quinidia* in the treatment of 180 cases of intermittent fever at the Philadelphia Almshouse Hospital. Of these cases, 111 were of the quotidian, 35 of the tertian, and 31 of the tertian and quotidian types successively. In 129 cases the paroxysms were arrested by fifteen grains of the salt.³ Similar results have been obtained by Dr. Peacock, who is of opinion that *quinidia* is less apt than quinia to disagree with the stomach, or to cause unpleasant nervous symptoms.⁴ *Amorphous quinia*, or *quinoidia*, is capable of checking intermittent fever, in doses two-thirds larger than those of sulphate of quinia. Dr. Da Costa found that in 49 out of 53 cases of quotidian or tertian intermittent fever, the paroxysms were arrested by the first day's administration of the medicine, to the amount of twenty grains.⁵

Mode of Action of Cinchona in the Cure of Periodical Diseases. The description furnished in the preceding paragraphs may, perhaps, assist us in forming an opinion regarding the manner in which cinchona becomes a remedy for periodical fevers. Originally a doctrine prevailed, and was strenuously defended by Morton, that the essential cause of periodical fever is a material agent, which he compared to a ferment. At that period the belief in such an agent did not rest upon the probable ground which the experiments and observations of Lancisi afterwards afforded it. From the time of the latter, the doctrine of Morton, although it has occasionally been obscured by transient medical systems, continued to be accepted by all the leading medical investigators of the subject, and is so at the present day.

It has, indeed, been urged against this opinion, that intermittent neuralgia, and other local affections, not of a miasmatic origin, and occurring in regions where no sources of miasm exist, are nevertheless curable by means of bark. This fact cannot be denied; yet, because non-miasmatic neuralgia in one place, and miasmatic fever in another, observe alike the law of periodicity, and both are curable by quinia, we are not at liberty to conclude that the nature and cause of the periodicity are the same in both cases. In truth the mightiest pheno-

¹ Hospital Facts and Obs., p. 133.

² Revue Méd., Dec. 1854.

³ Am. Journ. of Med. Sci., Jan. 1855, p. 81.

⁴ Times and Gaz., Nov. 1856, p. 442.

⁵ Med. Examiner, May, 1853, p. 295.

mena of the universe as well as the simplest functions of the animal economy, are governed by a law which impresses periodical mutations upon every animate and inanimate thing. This is strikingly visible when we study the revolutions of the animal functions, the uterine, digestive, and nervous, for example. It is not unreasonable to suppose that various causes may render actions morbidly prominent as intermittent phenomena, which usually pass unnoticed. Such a case is presented in the intermittent fever developed by the irritation of a bougie in the urethra, by worms in the bowels, by mental excitement, &c. But the whole history of true periodical fevers points steadily to the cause which nearly all observers have assigned to them, a material poisonous effluvium from decomposing vegetation. If cinchona cures diseases marked by both forms of periodicity, it does not necessarily cure them in the same way. It may counteract periodicity in the one by regulating and moderating a disorder of the nervous system, and in the other by directly neutralizing a material poison, or causing its elimination from the economy. It is true that the latter proposition does not admit of direct demonstration; but, admitting that a morbid element in the blood is the immediate cause of the paroxysms of periodical fever, some such mode of cure appears to be the most consistent with probability. For, looking only at the simpler forms of the disease in its early stage, and before any cachexia has been established, it is certain that the febrile paroxysms are arrested permanently by doses of quinia, which have no other sensible influence upon the vital phenomena. The antidotal power of the medicine is quite as evident as that of mercury or iodine in constitutional syphilis, or of the latter medicine in poisoning by lead, although the material proof, existing in the last named case, may be wanting in the two others. Moreover, just in proportion as periodical fevers are complicated with local inflammatory or other derangements, either primarily connected with the disease, or resulting from its long continuance, is the specific action of quinia impaired or lost, unless such derangements are immediate manifestations or effects of the morbid cause. On this account, probably, remittent fevers are less completely under the control of the medicine than those of an intermittent type, no matter how grave the latter may be. Yet even remittent fevers which approach the continued type most closely, are more curable by quinia than by any other means, and their inflammatory and functional derangements subside under the medicine with a rapidity and completeness, which is less explicable on any other supposition than this, viz., that the quinia has destroyed, eliminated, or rendered inert, some noxious principle contained in the blood.

The results of administering quinia at different periods before the paroxysm amply confirm the view of the subject which has here been taken. The sensible effects of a full dose of it are completely developed at the end of five or six hours, and yet it has been thoroughly demonstrated that in order most effectually to prevent a paroxysm quinia should be administered between twenty-four and forty-eight hours in advance of the attack. Now, even when buzzing in the ears and headache, with some confusion of sight, are produced, these symptoms begin to appear within half an hour after the medicine is taken, and subside within a period of from eight to ten hours. It is, therefore, after the sensible effects have ceased, that the curative power of the medicine is most strikingly exhibited. No medicine which operates simply by exalting or depressing the organic actions possesses this peculiarity, one which it seems impossible to comprehend except upon the supposition that its eliminative or antidotal, and not its dynamical action, is the chief agent in the cure which it achieves.

The more attentively the operation of quinia in malarial disease is examined, the more difficult will it be found to explain it by supposing that the virtue of the medicine resides either alone or chiefly in the sedative operation which large doses of it manifest, or in the stimulant action which is displayed by smaller quantities. If we were compelled to adopt either sedation or stimulation, as the exclusive key to its effects, we should find the latter to be best suited for the purpose; for what, after all, is a paroxysm of intermittent fever but a chill? This is its essential phenomenon. The fever which follows is but a reaction from the chill, and the sweat but a resolution of the fever. And, in those forms of miasmatic fever which tend towards continuity, and in which the initial chill is perhaps the only one of the attack, some local inflammation or congestion sustains the febrile action and prevents the periodical depression which would otherwise ensue. But this excitation is continuous and essentially morbid; it exhausts the powers of life instead of enabling them successfully to resist the disease. If instead of such a stimulus, the system, laboring under intermittent fever, experiences one that is salutary in its nature, the paroxysms may very often be arrested. When patients affected with this disease in the midst of a malarious locality are removed thence to a salubrious residence, the change of air in many cases suffices for the cure. The charms and amulets which occasionally suspend the attack can operate only by exciting the mind with hope or faith. The medicines, other than bark, which have been most renowned for the cure of intermittent fevers are all stimulants in small doses. Opium, on which the ancients depended for this purpose, and which no prudent

physician will even now neglect; wine and abundant food, which in the marshy districts of Europe, are still regarded as preservatives against the disease; the whole class of sudorifics, including hot bathing, violent exercise, &c.; above all, arsenic, the great succedaneum for bark, and whose stimulant, tonic, and eutrophic properties are so remarkable; all of these agents show by their cure of intermittent fever, to which of their properties cinchona and its preparations chiefly owe their virtues. Let it also be remarked, that every one of these *succedanea*, when administered in large doses, becomes sedative in its action. Excessive exercise exhausts, alcohol and opium narcotise; and arsenic produces a sedation which has many points of analogy with complete cinchonism.

We are far from attributing to the stimulant virtues of quinia the chief part in its curative effects, for the reason already assigned, viz: that the latter are most fully developed when the former have quite passed away; but the preceding considerations (which might, indeed, be greatly extended), prove that in doses sufficient to cure intermittent fevers, its operation is at least not sedative. If it should still be objected that enormous doses of quinia are necessary in pernicious forms of periodical fever, we reply that in such cases the medicine manifests none of its toxical properties, or only does so in a moderate degree. Do the malarial poison and the quinia, then, neutralize one another? If they do not, and the remedy acts physiologically, is it in virtue of its sedative operation that it counteracts a tendency, stronger than exists in any other disease, to a complete prostration of the vital powers? But let it be observed that the extraordinary doses of quinia referred to are given, and with the comparatively trifling effects stated, in the apyrexia, and when there is no visible tendency to counteract the natural operation of the remedy. But since its sensible operation is singularly slight, we are compelled to conclude either that it is not absorbed, of which there is no evidence, or that it is counteracted by the material poison which, upon grounds already stated, we must presume to exist in the system.¹

¹ As these doctrines are opposed to those which the admirable researches of M. Briquet have led him to adopt, the following epitome of his conclusions is here subjoined.

"The alkaloids of cinchona arrest the intermittent paroxysms of diseases, whatever their cause or nature, by lowering the action (*hyposthénisant*) of that portion of the nervous system which is concerned in the paroxysm, especially that which controls calorification and the circulation of the blood. It deprives this portion of the nervous system of its power to combine and direct the harmonious actions essential to the making of a united effort—to the accomplishment, that is, of the morbid operation which constitutes an intermittent paroxysm." (*Op. cit.*, p. 352.)

The reader may judge which of the two explanations, the one here given, or that in the text, is most in harmony with the admitted facts of the case.

Yellow Fever.—Peruvian bark was early employed in the treatment of this disease, either as a curative agent, or as a tonic in certain of its forms or states. Lind, who wrote in 1777, advised it in the advanced stages, and about the same time other physicians prescribed it as a prophylactic. Rush, Bayley, and Currie made trial of it in Philadelphia and New York, but abandoned it as decidedly hurtful; while, soon afterwards (1800), two Spanish physicians, Lafuente and Bobadilla, proclaimed it to be a specific when used early in the attack. But the latter opinion having been condemned by the almost unanimous verdict of those who were conversant with the subject, the medicine, when used at all, was prescribed only in cases marked by unusual debility and depression at the commencement of the attack, or as a tonic during convalescence.

After the introduction of sulphate of quinia into medical practice, the hope was entertained that it would accomplish what cinchona had failed to do, on account, as was imagined, of the greater bulk and the nauseous taste of the latter. As early as 1826, Lefort, a physician of Martinique, was induced by the resemblance which he fancied to exist, as many more had done, between yellow fever and periodical fevers, to treat the former with quinia. He regarded the experiment as successful. Yet the results which he obtained do not seem to have tempted others to imitate his method, for it was not until 1837 that it was proposed as a specific by Thévenot, of Guadaloupe (who, however, fell a victim to the disease), and by Dr. Blair, of Demerara. Quinia was about the same time brought forward in the same character by Dr. Harrison, of New Orleans. He was enchanted by its apparent success: "The fever," he writes, "was in most cases cut short as if by enchantment." But he adds that, nevertheless, patients sometimes died of black vomit after the arrest of the fever, and without having presented a single symptom of the disease in the interval.¹ In the epidemics of 1837 and 1839, at New Orleans, it appears to have been serviceable. During the former the practice of giving it in large doses was there inaugurated, about the same time as in Demerara. This method was, perhaps, suggested by the ordinary practice of American physicians in periodical fevers, which was also pursued and systematized by Maillot in the treatment of such affections in Algeria. The method was introduced by Dr. Hunt, and extensively employed by Dr. Mackie, then physician to the Charity Hospital of New Orleans.² Several physicians of that city, particularly Drs. Harrison and Fenner, were enthusiastic in their praise of a treatment which they now ventured to call *abortive*, and which consisted

¹ BELL'S Bulletin of Med. Sci., iv. 20.

² LA ROCHE on Yellow Fever, ii. 716.

in the administration of twenty or thirty grains of quinia at a single dose, and associated with opium or morphia. In the epidemics of 1837 and 1839 it appears to have been serviceable, but in that of 1841, which was of an inflammatory type, its utility was absolutely null. From 1847 to 1853 Dr. Fenner found that he was able to cut short and cure the fever by large doses of quinia at the outset; but the type of the disease so readily mastered was mild. In the graver epidemic of the last named year, Dr. Fenner again made use of the same treatment, but, he remarks, "candor requires me to state that this abortive practice did not answer my expectations, and, after giving it a fair trial, I abandoned it, and fell upon a milder course of treatment, which proved more satisfactory."¹ At the very time when this conclusion was reluctantly arrived at in New Orleans, Dr. Anderson, of Mobile, describing the treatment employed by the physicians of that city, employed these confident terms: "They used quinine in almost every case, regardless of age, sex, idiosyncrasy, or any other circumstance. They have every reason to be pleased with their manner of treatment, and, with their present experience, would not exchange it for any other that they have heard of. The marked and almost magical effect of a large dose of quinine at the outset was so apparent, that they would have considered it little short of trifling with human life to have adopted any other treatment." On the other hand, Dr. W. H. Van Buren, in his report on the use of quinia in Florida, states that he never saw "any decided and permanent good effects from its use in yellow fever, though it was prescribed in doses of every size in a number of cases in the autumn of 1841."²

These conflicting opinions and discordant results taken in connection with other and more particular accounts, will not allow us to draw any conclusions more positive than these: 1. That quinia is not a specific for yellow fever as it is for periodical fevers of every type. 2. That in mild cases which would probably recover under good nursing and an expectant treatment, the medicine may sometimes hasten recovery. 3. That, on the whole, the results depending upon quinia are no better, if, indeed, they are as good, as those of the treatment of symptoms sanctioned by general experience, and which the skill of the physician must modify to suit the genius of each epidemic of the disease.

Diseases of the Nervous System.—Neuroses. In all functional diseases of the nervous system, a tendency to the occurrence of periodical exacerbations is at times observed, and sometimes they present pa-

¹ Trans. Am. Med. Assoc., vii. 545.

² New York Journ. of Med., vi. 79.

roxysms not less distinct and regular than those of intermittent fever. This periodicity, although it is most regular when it results from malarial poisoning, is nevertheless observed in localities where no causes of miasm exist and no form of true intermittent fever ever originated. In some cases, especially those first referred to, in which the influence of malarial poisoning may be suspected, the attacks yield to comparatively small doses of quinia, without the aid of other medicine. In others, which are associated with and probably dependent on debility of the system, and especially upon an anæmic condition, quinia is comparatively ineffectual, while bark in substance insures recovery by means of its tonic and reconstituent power. In others, again, the disease is a purely nervous derangement, paroxysmal rather than periodical, and curable, if at all by quinia, only by large and sedative doses of this medicine.

It has been found that quinia acts less favorably, as a general rule, upon nervous affections which originate in the brain, or which affect the organs of the special senses, owing probably to the congestion of these organs, which it induces or aggravates. On the other hand, in attacks of spasmodic asthma, and of convulsive cough attending bronchitis, such as occurs during epidemics of influenza, it possesses unquestionable powers. In Kopp's asthma, or *laryngismus stridulus*, M. Merei states that he found its effects equally rapid and satisfactory in about one-half of a dozen cases for which he employed it. The cases in which it was prescribed by him were those of weak and obviously nervous infants, suffering for weeks or months from fits, but during the intervals free from all disease. For infants from four to six months old, he directed doses of nearly one grain of quinia every second hour, until the physiological action of the drug was manifested.¹ In periodical *palpitations* of the heart, B. Briquet states that this remedy exerts peculiar efficacy.

In more general forms of nervous convulsion, the bark is less successful. Such is the case with *epilepsy*. Tissot, and also Torti, relate instances of its success, but they appear to have been examples of intermittent fever with epileptic paroxysms, rather than true epilepsy. Indeed, this explanation is suggested by Torti himself regarding a case which he relates.² A similar example was reported by M. Hippéau in 1822,³ and since the introduction of quinia, several more may be added to the number. Thus, M. Mazade publishes a case which occurred during an epidemic of intermittent fever, and which was treated

¹ Month. Journ. of Med. Sci., Nov. 1850, p. 463.

² Therapeutice Specialis, p. 426.

³ DELASIAUVE, Traité d'Epilepsie, p. 378.

at first in daily doses of eight grains, and afterwards of fifteen grains of quinia and upwards. Several relapses occurred, but a permanent cure was at length effected.¹ In another case, quoted by M. Briquet from Taroni, the disease was produced by fright, and was cured after a treatment of three months.

The effects of the remedy in *tetanus*, chiefly, but not exclusively, of the idiopathic form, are more favorable. In a case of traumatic tetanus, reported by Dr. Malone, of Florida, the recovery of the patient is ascribed to quinia, given at first to the extent of fifteen grains, in three doses, at intervals of two hours, and then continued in doses of three grains every three hours. Ringing in the ears, and partial deafness, attested the operation of the remedy.² Other successful cases are reported by Drs. Bishop, of Ithaca, New York, Firna, of Milan,⁴ Gleizes,⁵ Cock,⁶ Coste,⁷ and Dr. G. O. Rees.⁸ Several cases are also referred to by M. Briquet.⁹

Neuralgia. This disease is essentially spasmodic or paroxysmal, and is sometimes regularly intermittent, quite independently of a miasmatic cause. In proportion to its assuming the latter type is it curable by quinia; but the medicine must generally be given in large doses. From ten to twenty grains, administered six or eight hours before the paroxysm, in divided doses, is usually required. Its efficacy is increased by opium.

As early as 1822, periodical neuralgia of the fifth pair was cured with sulphate of quinia by Piedagnel, Dupré, and Ribes. In 1834, Dr. W. A. Gillespie, of Virginia, published two cases of severe miasmatic neuralgia occupying the dental branches of the fifth pair, and cured by the same remedy.¹⁰ A similar case is reported by Nepple,¹¹ and one of great severity, affecting the same nerve, in a female exhausted by lactation and loss of rest, was cured by Mr. Hogg, with doses of from ten to fifteen grains of quinia, given until deafness ensued. Many other remedies had been tried in vain.¹² Other forms of neuralgia have also been found amenable to the power of this medicine. A case of femoro-popliteal neuralgia was cured by Dupré with quinia after depletion, revulsives, and opiates had failed to give relief.¹³

¹ Bulletin de l'Acad. de Méd., xiii. 849.

² Am. Journ. of Med. Sci., Oct. 1843, p. 376.

⁴ Archives Gén., 4ème sér., vi. 76.

⁶ Lancet, June 28th, 1851.

⁸ Times and Gaz., June, 1857, p. 644.

¹⁰ Am. Journ. of Med. Sci., May, 1834, p. 115.

¹¹ F. CUVIER, Thèse de Concours, 1838.

¹³ Philad. Journ. of Med., v. 436.

³ N. Y. Journ. of Med., ix. 201.

⁵ Abeille Méd., xiv. 91.

⁷ Ibid., July 5th, 1851.

⁹ Op. cit., p. 492.

¹² Lancet, Nov. 1850, p. 575.

Mondière cured, by its means, neuralgia of the uterus;¹ and Brachet, a case of severe urethralgia of long standing, and of an imperfectly intermittent type.² Sir B. Brodie cured one in which neuralgia of the inferior dorsal nerves occurred paroxysmally at night, by means of sulphate of quinia taken daily to the extent of half a drachm.³ Numerous examples of the efficacy of this medicine in neuralgia of the ulnar, sciatic, erural, and other nerves, are given by Dr. Handfield Jones.⁴ In all of these cases various other remedies had been employed, such as narcoties, iron, stimulant embrocations, and blisters; but the degree of improvement was evidently dependent more upon the quinia than upon all the other means together, in proportion as the disease assumed the periodical type.

Intermittent Paralysis.—Intermittent paralysis occurs in two forms, as one of the phenomena of a paroxysm of intermittent fever, and as an uncomplicated affection depending, however, upon malarial causes. The former, perhaps, is most frequently met with. M. Mazade has given an account of a case of each variety; in both instances the disease assumed the form of hemiplegia, in the one case quotidian and the other tertian. Both yielded promptly to full doses of quinia.⁵ In another more recent case, the type of the attack was double tertian, and the paralysis, which was general, involved both sensation and motion. A dose of ten grains of sulphate of quinia, followed, the next day, by one of twelve grains, put an end to the attack.⁶

Acute Articular Rheumatism.—Under an impression that this disease, which is so remarkable for its remissions and exacerbations, might yield to the same remedy as intermittent and remittent fevers, Peruvian bark was employed in its cure by Morton, and with such success as to induce other physicians to imitate his example. Among these was Fothergill, who describes a form of rheumatism which attacked children particularly, was very much disposed to migrate from joint to joint, and had regular evening exacerbations and morning remissions. A decoction of bark, with rhubarb sufficient to keep the bowels open, commonly removed the disorder in a few days with great certainty.⁷ But the most conspicuous advocate of this treatment was Haygarth, who learned it from Fothergill, and, like him and Morton, adopted it on the ground of supposed “analogies between an ague and a rheu-

¹ Archives Gén., 2ème sér. (1835), vii. 185.

² Abeille Méd., xiv. 201.

³ Essay on Local Nervous Affections (1837), p. 28.

⁴ Lancet, June, 1855, p. 577, and p. 603.

⁵ Bull. de l'Acad., xiii. 850.

⁶ Gazette Méd. de Toulouse, and Abeille Méd., x. 215.

⁷ WILLAN'S Miscell. Works, p. 262.

matic fever." Haygarth made use of it habitually and with great satisfaction for a period of thirty-five years. He insisted on the necessity of prefacing its administration with "sufficient evacuations of the bloodvessels, stomach, and bowels," as well as with sudorifics and the warm bath in certain cases. This preparation he held to be essential, and if, owing to its insufficiency, the bark disagreed, the latter was suspended, and depletion and evacuants were employed anew. Bark was prescribed by him in doses of from five to fifteen grains, gradually increased to twenty, thirty, or forty grains every two, three, or four hours. Under its use the pain, swelling, sweats, &c., abated speedily, and the cure was generally perfected without any permanent enlargement of the joints, or other disability.¹ The careful preparation of the patients by means of evacuant medicines will be here particularly noticed, for, doubtless, it is owing to a neglect of this precaution that many later observers have failed to obtain from bark the benefits described by Haygarth.² Cullen, for example, seldom found it useful, and in some cases hurtful. It appeared to him to be fitted for those cases only in which "the phlogistic diathesis is already much abated," and where, at the same time, the exacerbations are manifestly periodical.³ Several recent observers, who have pursued the method of Haygarth, have obtained similar results. Thus Dr. D. D. Davis declares bark to be "the most powerful remedy that can be employed," provided the acute stage be combated by means of evacuants, first, free depletion and then an emetic, followed by a purge of calomel and jalap, and, if necessary, local blood-letting. He prescribed the bark in doses of from twenty to thirty grains three or four times a day.⁴ Mr. Popham states that in acute rheumatism, unattended with effusion in the joints, and after the due employment of evacuants, "it prevents relapse or loss of strength and those unruly aches and pains that so often survive the original attack."⁵ Perhaps the only writer of authority who entirely condemns this method in the cases indicated by Haygarth, while professing to have conformed to his precepts, is Seudamore, who says: "I have repeatedly followed his authority in administering the bark in the first stage of the acute rheumatism, its use having been premised by due evacuations; but I do not remember

¹ A Clinical History of Diseases, 1805, p. 45, &c.

² He describes them in these words: "Except mercury in syphilis, there are few or perhaps no examples where a remedy can produce such speedy relief and speedy recovery in so formidable a disease. For many years I have been thoroughly convinced that the Peruvian bark has a much more powerful effect in the rheumatic than any other fever, and that it does not even cure an ague so certainly and so quickly."

³ Mat. Med., ii. 96.

⁴ Lancet, Jan. 1841, p. 572 and p. 718.

⁵ Dublin Quart. Journ., Sept. 1844, p. 59.

more than one case in which I found it successful. *À priori*, we could not expect it to be a medicine otherwise than injurious when a sympathetic inflammatory fever is present, and all the secretions, except that of the skin, which is irregular, are more or less impeded."¹ It is probable that the *à priori* views of Sir Charles prevented him from clearly discerning the truth. His objections are adapted to provoke the criticism passed upon those of Parry by Dr. Copland, who says concerning them: "They can have no weight when duly examined by the physician who has had any experience of the operation of this medicine in acute rheumatism."² Dr. Copland states that since 1819 he has always employed cinchona for this disease, as early in the attack as possible, after due evacuations.

Since the introduction of *quinia* into practice, it has supplanted bark in the treatment of rheumatism, and with as inferior results as in several other diseases. It has, however, been administered in two different manners, in small doses as a substitute for bark, and in large doses as a sedative. By the former method, it has entirely failed of its purpose, because it is not the equivalent of bark. This comparative ill success is amply set forth by Dr. Fuller,³ who insists that quinia should not be administered at all until the pulse becomes soft, the tongue moist, and the urine clear. He has, however, found it of essential service in cachectic states of the system, or when the patient has been exhausted by the attack.

The use of quinia in large doses, as a sedative, was commenced in 1842 by M. Briquet, to whom belongs the introduction of this method. Between the date mentioned and 1853, he treated two hundred and fifty cases of acute and chronic articular rheumatism by means of large doses of quinia. That is to say, beginning with from sixty to seventy-five grains a day, in divided doses, he reduced the quantity to forty-five, thirty, or even fifteen grains a day, according as its specific effects were induced. No other treatment was, in general, employed. This method was found least efficacious in highly inflammatory cases, and most so, on the other hand, in persons of a lymphatic constitution, and debilitated by previous disease, or by an antiphlogistic treatment carried to extremes. When many joints were involved, the disease yielded more readily than when it was confined to a single one. M. Briquet is persuaded that under this plan of treatment the disease is cured in less time, and with less loss of strength, and consequently is followed by a more rapid convalescence

¹ On Gout and Rheumatism, 3d ed., p. 665.

² Dict. of Pract. Med. (Am. ed.), iii. 687.

³ On Rheumatism, &c. (Am. ed.), p. 88.

than when other methods are employed. The patients also suffer less pain, and therefore do not lose their rest so much at night. On the whole, M. Briquet believes that the exclusive treatment by quinia is the most efficient in shortening the attack, in sparing the strength, and diminishing the sufferings of rheumatic patients.

But these conclusions are not fully sustained by other physicians who have made use of the same method. M. Monneret,¹ for example, employed the treatment by quinia in twenty-two cases of articular rheumatism, giving from thirty to ninety grains of the medicine daily, and for an average period of ten days; but, in only seven was the treatment completely successful, and in only three of these was the attack severe. He found, like M. Briquet, that whenever the disease tended to fix itself upon a joint the plan was unsuccessful, and, also, at the commencement of an attack when the local or general symptoms were severe. He also noticed that, like opium, the medicine appeared often merely to disguise the pain, for it returned upon the suspension of the treatment. Indeed, this facility of relapse is visible in the accounts published by M. Briquet himself, and M. Grisolle says of relapses that they occur oftener and perhaps more readily after this than after any other form of treatment.² M. Legroux has also published the results which he obtained by means of the treatment with quinia.³ But he administered it in smaller doses, not exceeding thirty grains a day, and generally gave even less than this. He reports that nineteen out of twenty-four cases were completely cured under the influence of quinia, but admits that a relapse occurred in five cases. It is of still more consequence to observe that in many cases he made use of bleeding, sometimes as often as three times in the same attack, and, besides this, purgatives and blisters. M. Vinet, who published numerous examples of rheumatism treated by sedative doses of quinia,⁴ found that very often this medicine was, of itself, inadequate to the cure. While asserting that it, on the whole, exerts a decided influence upon the disease, and that in one-half of the cases the action is prompt and permanent, he admits that in the other half it is slow and uncertain, or even null. Like the other writers cited above, he also states that it has no tendency to prevent relapses.

The method of M. Briquet does not appear to have been much imitated elsewhere than in France. Dr. Bence Jones says, concerning a single trial of it which he made, giving as much as one hundred

¹ Journ. de Méd. (1844), ii. 18. Compend. de Méd. Prat., vii. 389.

² Pathologie Interne, 7ème éd., ii. 873.

³ Journ. de Méd. (1845), iii. 10.

⁴ Archives Gén., 4ème sér., xvii. 106.

grains of quinia to the patient in twenty-four hours, that no alteration was made in the pulse, no effect was produced on the pain, nor on the swelling of the joints, and on the third day he was obliged to discontinue the treatment on account of the sickness which ensued.¹

It will have been remarked that M. Legroux employed quinia as an adjuvant merely, or to complete the cure commenced by antiphlogistic measures, or in much the same manner as Haygarth prescribed bark; and to this may probably be attributed his comparatively good success. But that success was less than what Haygarth himself could boast of. Indeed, on weighing carefully the whole subject, we are forcibly struck with the great superiority of the original method, and are persuaded that bark, in substance or in extract, would still be found a potent remedy for acute rheumatism, if its administration followed the use of depletion and purgatives, but that no special advantage is to be derived from the use either of bark or quinia, in rheumatism, unless these precautions are observed.

In *chronic rheumatism* the use of bark is indicated whenever the system is enfeebled, the perspiration excessive, and above all, when the disease is not confined to one or two joints. But even then the medicine will powerfully contribute to the success of such local measures as are appropriate.

In *gout* cinchona has been used for a long time. As early as 1714, Held proclaimed it to be "a divine remedy" for this affection; but Cullen, and after him Scudamore, limited its employment to the intervals between the attacks, to strengthen the digestion, and so ward off a return of the disease. Quinia has been used for its sedative property, in large doses, during the paroxysm, but it has had no success to recommend it, and the danger of excessive sedation in a disease which may so readily abandon its original seat to attack the essential organs of life, cannot be too strongly insisted upon.

Typhus Fever.—It was formerly a universal custom to administer cinchona, in substance, decoction, or extract, in the advanced stage of typhus fever, and, generally, to combat the typhoid state. The stage or state is characterized by great prostration, a languid cutaneous circulation, petechiæ, a foul and dry tongue, muttering delirium, stupor, and subsultus tendinum. When such symptoms exist there can be no doubt that alcoholic and medicinal stimulants and nutritious food become essential to the patient's safety. Among the medicines employed with great advantage is bark, and that preparation of it is best which was originally designed by Huxham to remedy this

¹ Times and Gaz., June, 1855, p. 565.

condition, and which is still known as his tincture. Even Cullen, little partial as he was to stimulant remedies, expresses no doubt respecting the usefulness of this method. He goes further, and even speaks approvingly of the practice employed by Dr. James, of endeavoring, by means of his antimonial powder, to procure a remission early in the attack, and then employing the Peruvian bark. After the introduction of quinia it was substituted for the bark itself, and in 1824 we find Dr. O'Brien attempting to demonstrate its efficacy when administered after the stage of excitement had passed.¹

But quite recently quinia has been used in typhus with a different object. Dr. Dundas, of Liverpool, starting from the singular hypothesis of the identity of the periodical fevers of the tropics with the typhus fever of Great Britain, employed quinia for the cure of the latter disease, in doses of from ten to twelve grains, repeated three or four times, at intervals not exceeding two hours. He asserts that in the great majority of cases of uncomplicated typhus, taken at the commencement, complete and rapid success may be counted upon.² Dr. Eddowes, of the Liverpool Fever Hospital, substantially confirmed these statements, as well as Drs. Steele, Gee, Stevenson, Glassbrook, Lister, and Gildersleeves, of the same city; and Mr. Hayward states that he obtained the most beneficial effects from the quinine treatment in seventy-nine cases of fever.³ Dr. Fletcher, of Manchester, employed this remedy in eighty cases of typhus. "In the majority," he says, "cinchonism established a permanent convalescence within forty-eight hours." Of the cases in which the typhoid character of the disease was prominent before the administration of the remedy, five-sixths were convalescent within fourteen days, and of persons under the age of puberty nine-tenths were cured within the same period.⁴ It is difficult to account for the singular unanimity of opinion among the gentlemen here referred to, unless the medicine had really displayed the virtues which they ascribe to it, or unless some delusion had possessed them all regarding it. Doubtless their intelligence and their accurate observation of the disease which they treated must form a sufficient answer to the latter suggestion. Possibly the fever may have been of an unusually mild type. It is singular, however, that in Edinburgh a very different verdict was pronounced in the matter now before us. Dr. Robertson treated eight cases of typhus according to the directions of Dr. Dundas, but no appreciable good effect was produced; on the contrary, the medicine sometimes caused cerebral excitement, followed

¹ Trans. Coll. Phys. Ireland, iv. 367.

² Med. Times, Oct. 1851, p. 346.

³ Lancet, Oct. 1852.

⁴ Times and Gaz., April, 1853, p. 422.

by coma of a very alarming character.¹ Dr. Bennett also made use of the treatment in seven cases of typhus. "In none of the seven cases," he informs us, "notwithstanding the physiological action of the drug was well marked, did it in any way cut short the disease, or produce, in its progress, so far as I could ascertain, any amelioration whatever."² Notwithstanding, therefore, the favorable accounts at first published of this treatment, we cannot discover sufficient grounds for its adoption.

The affection known as epidemic *cerebro-spinal meningitis*, and which is said to be a form of typhus, called by the Germans *cerebral*, and by the Italians *tetanic* and *apoplectic*, has been treated by quinia because it is subject to marked remissions; but the results have not been encouraging.³

Typhoid Fever.—Both Home and Cullen appear to have used bark in a form of fever which was probably the typhoid. The former speaks of it as useful when there is much prostration, with sweating and tremor;⁴ but the latter frequently found, as some recent observers have done in the case of quinia, that it aggravated the inflammatory state of the system, and determined fatal inflammation of the brain and of the lungs.⁵ From 1840 to 1842 quinia was used as a sedative in typhoid fever by several physicians of Paris, among whom were Blache, Manoury, and Broqua. M. St. Laurens, reporting upon the cases treated at the Hôtel Dieu, states that in doses of from twenty to forty grains it sometimes produced a marked subsidence of the pulse, but that the tongue became redder and drier, the thirst was increased, vomiting occurred, with epigastric pain, and sometimes the diarrhoea was considerable.⁶ In 1843, M. Louis presented a report to the Academy of Medicine upon a memoir of M. Broqua, in which the use of large doses of quinia was advocated in typhoid fever. The report concludes with the following resolution, which was adopted by the Academy, viz., that the utility of quinia, according to the method described, is far from having been proven.⁷ In an excellent essay by M. Jacquot, published in 1844, eight cases of typhoid fever are reported in which the medicine seems to have controlled the atonic symptoms and the exacerbations of fever in the second stage of the disease.⁸ Much more recently, Dr. Barclay, of London, used the medicine in eighteen cases of typhoid fever, administering it in doses of ten grains every four hours; but it was of no perceptible advantage.⁹ Dr. Peacock,

¹ Edinb. Month. Journ., July, 1852, p. 91.

² Ibid., June, 1852, p. 564.

³ Boudin, Typhus Cérébro-Spinal (1854), p. 156.

⁴ Clinical Exper., p. 13.

⁵ Works, i. 641.

⁶ Archives Gén., 3ème sér., xv. 5.

⁷ Bull. de l'Acad., viii. 624.

⁸ Archives Gén., 4ème sér., vi. 85.

⁹ Times and Gaz., Jan. 1853, p. 31.

who has examined the question carefully, found that under the quinia treatment the rate of mortality was increased, and the residence of the patients in the hospital prolonged.¹ A special method of administering the medicine has been advocated by Dr. Worms, of Paris. It consists in giving an antimonial emetic in the forming stage of the attack, followed by a twelve-grain dose of quinia. In the active period of the disease two doses of nine grains each are prescribed with an interval of seven or eight hours, and this prescription is repeated the following day. Thereafter the medicine is administered in gradually diminishing doses. Dr. W. alleges that by this plan the attack is often terminated in from five to eight days.² The treatment has, on the one hand, found an enthusiastic advocate in Dr. Leelere,³ but, on the other, has been stigmatized as incendiary by Dr. Petit,⁴ and admitted by one of its advocates, Dr. Florentin,⁵ to produce intestinal irritation of an alarming nature and even fatal issue.

With this testimony before him the reader will be better able to affix a just value to the conclusions of M. Briquet, the most earnest advocate of the treatment in question. He prescribed the medicine in doses of from fifteen to twenty-two grains a day in mild cases; in severe cases from twenty-two to thirty grains were given, and in grave cases from forty-five to sixty grains. He claims, and it cannot be denied, that the fever, as indicated by the state of the pulse and skin, subsides under the operation of quinia. The pulse falls on an average, from 96 to 70 after five days' use of the medicine in mild cases; and in those of a grave type from 98 to 75 in the course of two days. The nervous symptoms are in like manner palliated when they are ataxie, consisting of headache, titubation, agitation, and delirium, while the eye is bright and the face injected; they are augmented in the adynamic form with prostration, stupor, a dorsal decubitus, and a constant tendency to sleep or to coma. The irritant action of the medicine upon the intestinal canal is represented as being very limited. Yet it is urged as an important precept never to continue the quinia in large doses for more than a week at a time; and three cases are referred to, in one of which, gangrenous ulceration was found in the large intestine, and in two others an unusual degree of inflammation. In regard to the mortality in cases treated by quinia, it is admitted to be not less than the general average by other methods. On the whole this author concludes, that the quinia treatment is not one adapted for general and ordinary use in typhoid fever. It is suited only to cer-

¹ Times and Gaz., Jan. 1856, pp. 3, 33, 55.

² Abeille Méd., xiii. 211.

³ Ibid., pp. 321, 331.

⁴ Ibid., p. 241.

⁵ Ibid., xiv. 21.

tain determinate eases, and, perhaps, to particular epidemics; and in general, like most other remedies, ought only to be made use of to combat certain forms of the disease, or certain predominant symptoms.

From the foregoing summary of opinions and results derived from those who regard with partiality the treatment of typhoid fever with quinia, and from those whose experiments in its use have led them to condemn it, it is, we apprehend, abundantly clear that the remedy is one of secondary value if, indeed, it possesses any virtues at all in this disease. In small doses no peculiar benefits are claimed to proceed from it, and in large doses the hazards of its administration greatly outweigh its occasional usefulness.

In the *typhoid fever of children*, MM. Rilliet and Barthez administered quinia in divided doses amounting to about seven grains a day, and continued them for a period of from seven to fourteen days. They found it to diminish the frequency and fulness of the pulse, and the heat of skin, perspiration, and desquamation of the cuticle, while it increased the muscular strength. It did not occasion dryness of the mouth, nor, in the fatal cases, any irritation of the stomach.¹ But there is nothing to show that the disease would not have been as quickly cured and as safely treated by other means which would have spared the necessity of administering a medicine repugnant to the patients and of high price.

Quinia has been used by Prof. Reizius to prevent *puerperal fever*. During the prevalence of an epidemic of this disease in the Lying-in Hospital of Stockholm, he caused all of his patients for some time before their confinement to take a scruple of sulphate of quinia every day. He was of opinion that this measure contributed powerfully to stay the progress of the epidemic.²

In *smallpox* of a malignant type Peruvian bark was once strongly recommended as an alexipharmic and anti-putrescent remedy; and Monro was induced by its success in gangrene to use it in those typhoid forms of variola in which the pustules do not fill or when petechiæ appear.³ In the same disease Cullen prescribed it to correct loss of strength, and "a putrescent tendency of the fluids."⁴ Bardsley used quinia under the same circumstances in children, and with advantage,⁵ and Rilliet and Barthez mention a case of hemorrhagic variola which would have almost necessarily been fatal but for the administration of sulphate of quinia in doses of about six grains a day for ten days, given in divided portions.⁶

¹ Archives Gén., 3ème sér., xi. 187.

² Edinb. Month. Journ., Sept. 1851, p. 279.

³ Edinb. Med. Ess. and Obs., v. 87.

⁴ Works, ii. 164.

⁵ Op. cit., p. 142.

⁶ Mal. des Enfants, 2ème éd., iii. 101.

In *scrofula* of certain forms cinchona has always been considered a valuable remedy. Fordyce recommended it when the blood is impoverished, and when the solids are flaccid, the glands enlarged, or the eyes inflamed.¹ Fothergill found it highly beneficial in similar cases to these, but useless where the bones are affected or the joints;² and, in our own time, Lebert pronounces powdered bark in large doses the best remedy for scrofulous ulcers and abscesses.³ In an affection of the *eye*, attended primarily with amaurotic symptoms, and afterwards with those of chronic inflammation of the iris and cornea, Mr. Wallace, of Dublin, found bark and quinia the most efficient agents of cure.⁴ Dr. Mackenzie pronounces the use of sulphate of quinia an improvement in ophthalmic medicine perhaps scarcely less important than the treatment of iritis with mercury. After a trial of numerous remedies for phlyctenular ophthalmia he found none so useful as this; in scrofulous corneitis the remedy, although slower in its operation, was not less beneficial; and in chronic scrofulous iritis with intolerance of light, smallness of the pupil, dulness or discoloration of the iris, with zonular redness, *without effused lymph*, mercury, he says, is not called for and quinia is more likely to do good.⁵ Mr. Middlemore has also found quinia of signal service under circumstances similar to the above.⁶

Although bark cannot cure tubercular *phthisis*, nor even *chronic bronchitis*, yet there are states of both diseases in which it may become very serviceable. These exist when there is a rapid wasting of the system under the influence of profuse expectoration and night-sweats. The acidulated cold infusion of bark often tends materially to lessen the discharges as well as directly to improve the strength. Cullen found bark most useful in cases of hectic fever in which the morning remissions and evening exacerbations were most distinctly marked. It often suspended the paroxysms for a considerable time. Where the sweats result from debility alone the benefit is more permanent. Such is the case during convalescence from many acute diseases, after unduly prolonged lactation, &c. It is equally beneficial in cases of great susceptibility to catching cold in consequence of a languid circulation and an impoverished state of the blood. Indeed there is hardly any asthenic form of disease in which it is not applicable. Dr. Corrigan has strongly recommended quinia for this form of *pneumonia*, in doses of five grains every three hours,⁷ and Dr. Gor-

¹ Med. Obs. and Inq., i. 184.

² Works, ii. 16.

³ Maladies Scrophuleuses, p. 302.

⁴ Med.-Chirurg. Trans., xiv. 297.

⁵ Diseases of the Eye, 2d ed., pp. 390, 460, 493, and 524.

⁶ Lond. Med. Gaz., July, 1831, p. 545.

⁷ Am. Journ. of Med. Sci., Oct. 1856, p. 486.

don found the same treatment successful in similar cases, which he regards, no doubt correctly, as examples of vascular engorgement rather than inflammation of the lung. Although diffusible stimulants acted favorably upon the symptoms they were less efficient than quinia.¹

The state of muscular debility and nervous excitability which often occurs during the second stage of *whooping-cough* is almost always improved under the influence of quinia, or, still better, of bark. Cullen thought that it seldom failed to cure, and it has been spoken of favorably by Trousseau, Barrier, Rces, Johnson, and Copland, in cases where the paroxysms tend to assume the periodical type, or when the general state of the patient calls for tonic treatment.²

Dr. Macfarlan, of Williamsburg, N. Y., claims for quinia a power of curing "croup," and gives it the preference over nitrate of silver, emetics, and calomel. In support of his opinion he has published four cases,³ of which one was a case of laryngeal spasm produced by a fungus of the trachea, which afterwards proved fatal, and the other three were clearly examples of spasmodic laryngitis, which would certainly have got well even without the use of sulphate of quinia in doses of from one-third of a grain to one grain every half hour.

In several diseases of the *digestive organs* bark or quinia may be of signal service. M. Hervieux has reported a rare and curious case of *mucous flux* from the pharynx which offered a daily remission or suspension, and was cured by means of sulphate of quinia.⁴ In *atonic dyspepsia* bark and quinia are sometimes beneficial, but less so than the simple vegetable bitters, on account of the astringent and irritant operation of the former. They are most appropriate in cases where the gastric atony is shared by the system generally. In epidemic *dysentery* at an advanced stage of the disease or when those adynamic symptoms appear which denote disorganization of the blood, bark is often of great service, especially in hot climates. In chronic *dysentery* quinia is of little use by means of its local operation, but by its tonic influence it may co-operate with other remedies to promote the restoration of the diseased mucous membrane of the colon to its normal condition. In many other cases in which a mucous membrane is the seat of a chronic discharge, as in affections of the *bronchia*, and of the *genito-urinary organs*, and even in *chronic abscesses* opening externally and secreting a strumous liquid, the administration of quinia, or, still better, of bark, is often attended with the best results.

¹ Dublin Quart. Journ. of Med., Aug. 1856, p. 103.

² GIBBS, on Whooping-Cough, p. 308. ³ New York Journ. of Med., N. S., xiii. 364.

⁴ Bulletin de Thérap., l. 442.

Various bitter substances have been used successfully as *anthelmintics*, such as quassia, absinth, and gentian. Cinchona was recommended as a vermifuge in the last century; but more recently M. Delvaux, of Brussels, has employed it and also the sulphate of quinia. He states that in more than forty cases he has expelled lumbrici by its use, and cured two cases of tænia. Yet he gave it in only one or two grain doses repeated four times a day. He also found enemata containing quinia effectual remedies for *oxyures vermiculares*.¹

Gangrene, both spontaneous and traumatic, has occasionally been arrested by the use of bark. In *scurvy* it has always been regarded as having peculiar virtues due to its combined tonic and astringent operation. It was long ago regarded as of great value in various forms of passive *hemorrhage*, and especially of hemorrhages from ulcerated surfaces. The special indication for its use is impoverishment of the system, on the one hand, or the occurrence of the loss of blood at regular intervals. Cullen advised it in *menorrhagia* of this sort, or, as he expressed it, depending on "laxity of the extreme vessels." Dr. Tilt found quinia a very effectual remedy for *irregular menstruation*, accompanied with nervous symptoms, pain and exhaustion, and more or less leucorrhœa during the inter-menstrual periods.² Under corresponding circumstances it should be used in the treatment of *amenorrhœa*, but associated with iron and aloetic laxatives.

Bark and Quinia administered by the Rectum.—The administration of bark by enema, especially to children and other persons who cannot readily take it by the mouth, is an old practice, employed by Baglivi, recommended by Helvetius and Home, and mentioned by Cullen. In more recent times, sulphate of quinia has been administered in the same manner. Bretonneau states that a mixture of two drachms of powdered bark with twenty grains of quinia is more apt to be retained than a solution of thirty grains of the salt alone.³ In cases of children at the breast, Herpin has used successfully small injections each containing two grains of the salt, and a small quantity of laudanum when there is diarrhœa.⁴ Trousseau recommends a rather smaller dose than is usually given by the mouth, and M. Kuhn, of Niederbronn, maintains that half of the latter dose is sufficient, and recommends that, in order to facilitate absorption, the salt should be much diluted. He thinks this plan peculiarly suitable in cases of obstinate intermittent neuralgia.⁵ M. Briquet, who admits the very rapid absorption of the salt from the large intestine, contends,

¹ Abeille Méd., xii. 152.

² Lancet (Am. ed.), vol. i. 1851, p. 307.

³ Journ. de Méd., iii. 68.

⁴ Bull. de Thér., xlix. 330.

⁵ Bull. de l'Acad., xviii. 857.

however, that it exerts but a slight medicinal influence. Its physiological effects are certainly less marked when it is administered in this manner; but the proofs of its curative operation rest upon independent grounds.

Endermic Application.—Home states that in his time curative effects were sometimes obtained from baths made with a decoction of bark, or by wearing a vest in which coarsely bruised or powdered bark was quilted.¹ In 1759, Pye reported twelve cases of ague cured by the latter means.² Cataplasms made of powdered bark and wine, and applied to the abdomen for twelve or eighteen hours, are stated by Trousseau to be sometimes employed. But the most numerous proofs that the virtues of bark are manifested through its external application are furnished by Chrestien,³ who has published in detail upwards of forty cases of periodical and bilious fevers, &c., in which he employed successfully the tincture and the resinous extract of bark applied with friction to the skin.

But the application of quinia to the denuded cutis has generally supplanted these methods. An account of its successful use was first published by Lesieur in 1826.⁴ In the following year, Martin, of Narbonne, also used it with advantage, incorporating the quinia with simple ointment in order to diminish the irritant effects of the remedy,⁵ and Avenel was equally successful with the powdered sulphate applied to the denuded cutis of the arm.⁶ In 1826, Pointe claimed to have effected cures by this method, and also by rubbing the salt into the mucous membrane of the mouth.⁷ In 1828, Speranza cured fifteen cases of tertian intermittent by applying eight or ten grains of sulphate of quinia in an ointment to a blistered surface upon the arm. In most of the cases, a single application sufficed.⁸ In 1830, Dr. Gerhard's interesting experiments confirmed the previous results. This physician treated upwards of twenty cases of intermittent fever by the endermic method. Nine were of the tertian and the remainder of the quotidian type. In twelve cases, no chill occurred after the first application; in all of the others the disease was cured after one paroxysm, with a single exception, in which it was arrested after the third.⁹ In 1833, Dr. Christian, an Irish practitioner, employed the method successfully without being aware that it had previously been used.¹⁰

¹ Clinical Exper., p. 12.

³ Méthode Iatroleptice, Montpell. an. xii.

⁵ Revue Méd., xxvii. 569.

⁷ Archives Gén., Sept. 1826.

⁸ N. Amer. Med. and Surg. Journ., viii. 199.

⁹ Ibid., ix. 397.

² Med. Obs. and Inq., ii. 245.

⁴ Archives Gén., xi. 300.

⁶ Ibid., xxviii. 21.

¹⁰ Lancet, Feb. 1833, p. 689

About the same time, the endermie mode of administering quinia was used successfully in Germany by several practitioners, especially by Berndt and Lieber.¹ In 1839, M. Dassit cured four cases of intermittent fever in children by means of frictions with an ointment of sulphate of quinia applied to the axillæ.² M. Briquet is disposed to regard the application of cinchonic preparations to the sound skin as a precarious and feeble resource, and the use of quinia upon the denuded derm as too painful to be tolerated; but it should be borne in mind that these methods are proposed as substitutes for the ordinary plan only when the latter and the administration by enema are impracticable. In such cases, and with the precaution of diluting the salt with starch or with an ointment before applying it directly to the derm, the plan presents no objectionable feature.

ADMINISTRATION. *Powdered Bark.*—The yellow calisaya, or the new Carthagena bark, is to be preferred for internal administration. As a tonic, it may be given in doses of *half a drachm or one drachm* daily; as an antiperiodic, the quantity necessary to prevent the return of a paroxysm varies from *a drachm to an ounce*, according to whether the attack is simple or pernicious, or whether the patient is treated in or at a distance from a miasmatic locality. Bark may be given in substance mixed extemporaneously with water, or made into a bolus with syrup or honey; but in this manner it is very nauseous, as well as disgusting in appearance. It is more readily tolerated when the vehicle employed is a light French or German wine, and when the mixture has been made for some time before. A sweetened infusion of coffee masks the bitterness of the medicine, as it does, to some extent, that of quinia. Elliotson, and also Neligan, have recommended milk as a very excellent vehicle. It is, however, always objectionable to employ any article of food as the excipient of a disagreeable medicine.

Decoctions and Infusions.—These preparations are used only as tonics, and in the dose of *two fluidounces* three or four times a day.

Tinctures.—The simple tincture may be given in doses of from *one to four fluidrachms*, and the compound tincture in doses of *a fluidrachm*, whenever a stimulant as well as a tonic effect is desired. Their principal use is in typhoid states of disease, and to counteract the debility which precedes convalescence after various exhausting maladies.

Extracts.—The extracts of yellow and red bark are recommended

¹ A. L. RICHTER, Die Endermische Methode, 1835, p. 103.

² Bull. de Thérap., xvi. 273.

to be given in doses of from *ten to thirty grains*. They are exclusively employed as tonics, and frequently with great advantage when the preparations are genuine.

The *fluid extract* is of more uniform strength, and is a very efficient tonic in the dose of about twenty minims, which is equivalent to a drachm of bark.

Sulphate of Quinia.—The dose of this salt as a tonic is *one grain*, repeated three or four times a day. As an *anti-periodic* in simple intermittent or mild remittent fever, *six or eight grains* are sufficient to avert the paroxysm; in severer cases of these affections the dose must be raised to *fifteen or twenty grains*, and in those of a malignant type to *thirty, forty*, or even *sixty grains*, given in both of the latter cases in divided doses. Intermittent neuralgic diseases require doses sufficient to produce the physiological effects of the medicine in a marked degree.

The intense bitterness of quinia has led to the invention of various methods for its administration. These are probably of secondary importance relatively to its therapeutical effects, for, as Mialhe has observed, it is quinia, and not its sulphate or any other salt, which operates upon the system. For in whatever way the base is combined it undergoes decomposition in the blood by means of the alkaline carbonates contained in that liquid.¹

Sulphate of quinia may be administered in powder, enveloped in a wafer made with flour and the white of eggs, in thick mucilage or jelly, or in pills coated with gelatin, or covered with silver or gold leaf. But all of these methods are objectionable, because they bring the pure salt in contact with the mucous membrane of the stomach, and lead to its irritation. Quevenne, and also Bertella, have shown that a syrup acidulated with citric or tartaric acid, serves partially to disguise the bitterness of the medicine. Various bitter and astringent liquids fulfil this purpose still more completely, such as tannic acid, coffee, and tea, but the mixture produces a precipitate of the insoluble tannate of quinia, which is probably decomposed but slowly in the stomach. M. Bouvier insists that the antiperiodic virtues of the tannate of quinia are equal to those of the sulphate, while it is less irritating to the stomach, and affects the nervous system less.² By far the best form in which sulphate of quinia can be given is that of solution in water acidulated with aromatic sulphuric acid, in such manner as that each tablespoonful of the liquid shall contain one grain of the salt and one drop of the acid. One or two drops of

¹ Chimie Appliquée, p. 510.

² Bullet. de l'Acad., Fev. 1852.

laudanum should generally be added to each dose in mild forms of intermittent, and from five to ten drops in the grave forms.

Crude Quinia.—This preparation may be given in the same doses as the sulphate of quinia. It is insoluble in water, and its slight bitterness renders it appropriate for administration to children and others who object to the taste of the sulphate. It may be given in some mucilaginous liquid, in syrup, honey, or preserves. As it must dissolve slowly in the stomach, a longer time is necessary for it than for quinia to develop its effects.

Quinoidin or *Amorphous Quinia* may be administered in the same manner and in the same doses as erude quinia.

Sulphate of Quinidia may be prescribed in the same manner as sulphate of quinia, and *sulphate of cinchonia* in doses one-third larger.

Besides those which have been mentioned, and which alone are generally used, several other preparations have been proposed. The following are the most important of these: the *muriate*, which is not a permanent salt; the *arsenate*, and the *arsenite*, whose irritant properties render them objectionable; the *sulpho-tartrate*, which M. Bartella¹ conceives to be more active than the sulphate, but which M. Briquet has shown to be feebler physiologically as well as therapeutically; the *tannate*, which, according to the same authority, is six or eight times less active than the sulphate; and the *ferrocyanate*, which Dr. Wooten, of Alabama, found more powerful than the sulphate as a nervous sedative,² but which the experiments of M. Briquet prove to be imperfectly absorbed, and feeble in its action even when twenty or thirty grains a day are given in divided doses.

SALIX.—WILLOW BARK.

DESCRIPTION. *The bark of Salix alba. U. S.*—The barks of other species of willow may be used with equal advantage. The genus *Salix* comprises a great number of species which are natives of North America and Europe. The officinal variety comes from the latter country, but is cultivated in the United States, along the borders of small streams, and its young and pliant branches are employed for making baskets, and its wood in the manufacture of gunpowder. When allowed to grow it becomes a tall tree, with numerous branches, the younger of which have a delicate greenish color. The leaves, which are shining, and white on the under surface, are lance-shaped, alternate, and have acutely serrated edges.

¹ Bull. de Thérap., xiv. 534.

² Am. Journ. of Med. Sci., Jan. 1847, p. 252.

The bark obtained from the smaller branches, of two or three years old, is found rolled in quills, of a slightly aromatic odor, and a bitter and astringent taste. Its virtues, which it yields to water and to alcohol, appear to depend upon a peculiar proximate principle, *salicin*, and upon *tannic acid*. Salicin is a white, transparent, crystallizable, neutral substance, of a silky lustre, without odor, and very bitter and astringent. It is soluble in water, and more readily in alcohol.

HISTORY.—Willow bark was anciently employed in medicine, but almost exclusively as an astringent. It seems, as well as the leaves, to have been a popular domestic febrifuge before it was introduced into medicine. Mérat and De Lens, who carefully investigated its medical history, state that in Austria, in 1694, Ettner used an infusion of the leaves as a febrifuge.¹ It was first recommended in the treatment of intermittent fever by Stone, of London, in 1763, who reported the cure of fifty patients by its use.² In 1772, Gunzcius proposed it as a substitute for cinchona, and from that time to 1825, when Fontana announced salicin as the active principle of the bark, it was successfully employed as an anti-periodic remedy by Koenig, Coste, Willemet, Vauters, Burtin, and others.

ACTION AND USES.—Like the simple bitters, willow bark appears to augment the appetite and improve the digestion, and if its use is long continued it confines the bowels. It also manifests a decidedly anti-periodic power in intermittent fevers.

Given in the form of infusion, or of powder, which is said to agree better with the stomach than powdered cinchona, willow bark is useful in many cases of *feeble digestion*, and of *general debility* induced by excessive discharges of pus or other liquids. It has been thought to be particularly useful in chronic mucous discharges from the urinary passages, and also from the lungs. It has also had some repute as a *vermifuge*. Powdered willow bark, like powdered cinchona, is sometimes used as a dressing for *gangrenous* or otherwise fetid or unhealthy sores.

Salicin is said to possess the tonic power in a very slight degree, but it often manifests decided anti-periodic virtues. On its first discovery, and subsequently, the reality of this property was attested by Girardin, Miquel, Andral, Lobstein, Barbier, Blom, Pleischl, and other physicians. According to Barbier, and also to Pleischl, it is a very efficacious remedy, and sometimes cures cases of *intermittent fever* which have resisted quinia.³ Blom employed it chiefly when quinia was contraindicated by vascular congestion of the head, and violent head-

¹ Dict. de Mat. Méd., vi. 179. ² MURRAY, App. Med., i. 67. ³ Mat. Méd., i. 395.

ache.¹ Dr. Fenner, of New Orleans, tried this medicine in twenty cases of intermittent fever, giving it in doses varying from five grains to a drachm, the average amount taken by each patient being one hundred and eighty-eight grains. It was successful in eleven cases only. Its general effects seemed to be tonic and diaphoretic.²

Now that it is well known that at least one-half the number of cases of recent intermittent fever may be cured without a specific remedy, merely by transferring the patient to a salubrious atmosphere, and surrounding him with otherwise favorable hygienic conditions, the peculiar virtues attributed to willow bark, and its proximate principle, are more than ever questionable. They are seldom appealed to by physicians, yet they may occasionally be invoked in the absence of quinia, or when this medicine is objected to, or disagrees with the patient.

ADMINISTRATION.—Powdered willow bark may be given in doses of half a drachm or a drachm three times a day, as a tonic; as an anti-periodic, the dose must be repeated, so that at least an ounce shall be taken during the intermission. A decoction or infusion may be made with an ounce of the bark to a pint of water. The dose of salicin, as an anti-periodic, is stated at five grains, and it should be repeated during the apyrexia, until thirty or forty grains are taken.

CORNUS FLORIDA.—Dogwood.

DESCRIPTION.—Dogwood, which is a native of this country, is a small tree which abounds in rich and shady lands, and is conspicuous for the white involucre of its flowers in the spring, and by its brilliant, shining, red berries, and its many-colored leaves in the autumn. The wood is hard and compact, and the younger branches fibrous when broken. The officinal portion of dogwood is the bark, especially that of the root. It is of reddish-gray color, has a very slight odor, and a bitter, astringent, and slightly aromatic taste. It yields its virtues to water and to alcohol. It has been alleged that they are due to a peculiar principle called *cornine*, the separate existence of which, however, has not been demonstrated. According to Dr. John M. Walker, in 1797, it contains extractive matter, gum, resin, tannin, and gallic acid.

MEDICAL PROPERTIES.—This substance is tonic, astringent, and slightly stimulant, and in the recent state is apt to excite nausea.

¹ Edinb. Med. and Surg. Journ., Oct. 1837.

² N. Orleans Med. and Surg. Journ., ii. 415.

Various practitioners have testified, with probably more zeal than knowledge, that it is equal to cinchona in the treatment of *intermittent fever*. Where the latter remedy cannot be procured dogwood bark may be tried, and will, doubtless, like other vegetable bitters, occasionally succeed. As a simple tonic its efficacy is unquestionable. The ripe fruit infused in brandy is a popular stomachic.

The dose of the bark in powder is twenty grains as a simple tonic, and a drachm, repeated six or seven times during the apyrexia, as an anti-periodic. The decoction, which is officinal, is made by boiling an ounce of the bruised bark in a pint of water in a covered vessel for ten minutes. It may be given in doses of two fluidounces.

C. sericea, or *swamp dogwood*, possesses the same general qualities as the above species, but is less bitter and more astringent; *C. circinata*, or *round-leaved dogwood*, which is most common in New England, is very bitter, and is much employed in that region as a tonic and stomachic.

PRUNUS VIRGINIANA.—WILD CHERRY BARK.

DESCRIPTION.—The inner bark of *Cerasus serotina*, according to the present botanical nomenclature. The officinal appellation belongs to *Cerasus Virginiana*, or *choke-cherry*.

The wild cherry is a large tree which abounds in most parts of the United States, but attains its greatest height in the Southern States. The leaves are smooth on both sides, pointed, and serrated on the edges. The flowers, which are white, have a smell of bitter almonds, and the fruit, which is in pendulous racemes, consists of round blackish berries, which have a pleasant, but somewhat astringent taste. It is eagerly devoured by birds.

The bark of the roots and branches is employed in medicine, but the former is preferred. It is found in the shops deprived of its epidermis, of a reddish-brown color. It is readily pulverized. It is bitter and aromatic in taste, and when fresh has the smell of bitter almonds. According to the analysis of Mr. Procter, it contains resin, amygdalin, starch, tannin, gallic acid, &c., and on distillation with water, it yields a volatile oil combined with hydrocyanic acid. These products are ascribed to a fermentation produced between the water and the amygdalin of the bark under the influence of an albuminous principle, emulsin, which has the property of converting amygdalin into volatile oil of bitter almonds. If an infusion be made with hot water, this con-

version does not take place, for the agent in producing it, emulsin, is coagulated.

ACTION.—It will be perceived from the preceding account, that wild-cherry bark possesses a very anomalous constitution, containing, as it does, a tonic, and also a directly sedative ingredient. These influences, however, which at first sight appear incompatible, are in reality not so; for there are many morbid conditions in which excitability of the nervous system, and sometimes even of the heart, is associated with debility of the organic functions, and particularly of digestion. Indeed, we have in this medicine a combination not unlike those which are so frequently employed in chlorosis, and which are adapted to control nervous irritability on the one hand, and to impart tone to the system on the other. If it were more powerful, the field of its usefulness would be greatly enlarged.

From the experiments of Dr. Morris, in 1802, it was inferred that the action of wild-cherry bark, in half drachm doses, is primarily to *quicken* the pulse, but ultimately to render it fuller and stronger.¹ Dr. Eberle also says, that "when taken into the system, it produces a slight increase of the action of the heart and arterics, and induces, in some individuals, considerable drowsiness." He adds, however, "when it is taken in *large* quantities, and frequently repeated, it weakens the digestive organs, and produces an effect upon the action of the heart and arteries, the very reverse of a stimulant. In my own person, I have several times reduced my pulse from seventy-five to fifty strokes in a minute, by copious draughts of the cold infusion, taken several times a day, and continued for twelve or fourteen days."² Dr. F. P. Porcher states that having employed several ounces of the infusion three times a day in a case of hypertrophy of the heart, the force of the patient's circulation was at first diminished; but the abatement was not progressive.³ These effects, even in what they appear to be discordant, resemble those produced by medicinal doses of prussic acid. It is also to be observed, that in Morris' experiments the powder was used, and in those of Eberle and Porcher, the cold infusion; so that in the former case it is probable that but little prussic acid was generated, and the tonic action of the medicine predominated. The large doses of the infusion taken by Eberle, before a sedative effect was produced, show that very little of this effect is to be looked for from the ordinary doses of this preparation.

USES.—Wild-cherry bark is more employed in the treatment of

¹ DR. CARSON, in Pereira's Mat. Med., 3d Am. ed., ii. 777.

² Mat. Med. and Therap., 6th ed., p. 213.

³ Trans. Am. Med. Assoc., ii. 737.

tubercular consumption, than in any other affection. It is supposed to improve the appetite and strengthen the digestion, while it palliates the cough and allays the irritability of the nervous system, when this arises under the exhausting progress of the disease. As a gentle and harmless palliative, it is certainly to be recommended, but no evidence that can be called rational, exists to show that it in the least degree postpones the inevitable issue. In so-called nervous coughs, or those in which the act of coughing is excited by disease elsewhere than in the lungs, or when the cough in slight bronchial or laryngeal irritation is violent in proportion to the local cause, this medicine is often of singular efficacy. In some cases of the kind the syrup forms an eligible preparation.

It is of much more evident utility in the *convalescence from acute diseases* accompanied with exhausting discharges, when the nervous susceptibility is manifested by a still lingering daily exacerbation of fever. Although inferior to cinchona in this respect, it is more agreeable to the patient, and often of sufficient power to enable the system to pass with ease and speed through convalescence. When once the febrile erethism has been subdued, and the appetite and digestive powers begin to improve, the simple bitters are greatly to be preferred.

From a knowledge that this bark contains prussic acid, it has been used to allay *excessive action of the heart* in organic as well as functional affections of this organ, and there are many who confide in its efficacy. The experiment of Eberle upon himself, and the case related by Dr. Porcher, prove that, except in enormous doses, the medicine is inefficacious in reducing the heart's action, at least for any length of time. Doubtless, when the palpitations depend upon anæmia, it may form a useful adjuvant to iron, calming excitability, while exerting some tonic influence; but its value here is altogether secondary. If irregular action of the heart depends upon organic defects alone, it is possible that the bark may sometimes moderate its tumult and thus assuage the suffering which arises from that cause. Although we have used the medicine a good deal in such cases, we have never witnessed any effects from it beyond that of gratifying the patient with a pleasant and slightly tonic beverage.

ADMINISTRATION.—Wild-cherry bark may be given in the form of powder, infusion, or syrup. The first is never used, but the dose of it is usually stated at thirty or forty grains several times a day.

The *infusion*, which is officinal, is directed to be made with cold

water in the proportion of half an ounce of the coarsely powdered bark to the pint of water. It is best prepared by displacement.

The Pharmacopœia directs a *syrup*, which is a very agreeable preparation, and may be used as a vehicle for other sedative or narcotic medicines, or as a sweetener for cough mixtures in cases unaccompanied by acute fever.

SIMPLE BITTER TONICS.

MEDICINES belonging to the group of tonics generally denominated simple bitters contain a bitter principle, which is crystallizable in some cases, but not in others, and upon which, in each instance, their virtues are supposed to depend. Although exceedingly simple in their operation, exerting, as they do, no influence beyond augmenting the appetite and invigorating the digestive organs, it is easy to perceive that their applications in practice must be very numerous. There are few cases of acute disease in which the decided improvement of the patient does not date from an awakening of the appetite for food; and whenever this instinct is not spontaneously developed—whenever the patient continues languishing and suffering beyond the ordinary period of convalescence, although no apparent cause should account for the delay—an indication exists for the administration of bitter tonics. Even when the appetite revives, if it does not manifest a due degree of vigor—if the food appears to lack its proper flavor, or if it oppresses the stomach and disturbs the bowels, although of the proper quality and used without excess—a few doses of gentian, Colombo, or quassia will frequently restore its natural zest to appetite, secure a good digestion, and promote the health “that waits on both.” Such cases present the most signal instances of the utility of these medicines, which often appear to form the necessary means of passage from sickness to health.

But in more chronic cases of gastric debility they are also of essential service. In almost all diseases of long duration, in which the patient is exhausted by discharges of blood, pus, or other liquids, or endures severe pain, or, finally, is habitually deprived of his needful rest, the digestive function sooner or later becomes impaired. If, before its powers have sunk too low, these medicines are administered, they enable the stomach to compensate, by its supply of nutritive materials, for the waste of tissue which the disease occasions, and thus

sustain the system until the primal cause of its exhaustion is removed. There is a form of gastric debility which is exceedingly common in this country, as well among persons who are exhausted by bodily toil as among those whose minds are perpetually harassed with the calculation of pecuniary gains or depressed by the passions (too often of the baser sort) which assail those who enter into the political struggles of the day. In many cases, it is true, this condition is induced by an abuse of alcoholic stimuli; but in many, also, its origin is in the incessant, unrelaxing application of mind or body, or of both, to the details of business. By such influences a disorder of the stomach is induced in which acidity, flatulence, and often pain, are superadded to a simple want of vigor in the digestive function, constituting the most ordinary form of chronic dyspepsia. Still more important symptoms may ultimately be developed, consisting of various disorders of the nervous system, and not unfrequently terminating in hypochondriasis or other form of mental derangement. The primary cause of these manifold evils is oftentimes the disordered function of the stomach. In the forming stage of the complaint the medicines under consideration are frequently adequate to the cure; but when once the lower bowels and the liver have become torpid, and the muddy hue of the skin, the icteroid hue of the eye, and the loaded tongue denote an alteration of the circulating fluid itself, and a disturbance of the nervous functions, they are not sufficient by themselves to give relief. Their use must be preceded by evacuants—by emetics, purgatives, and cholagogues; and by the warm bath, or some other appropriate stimulant of the skin. These various agents reduce the disorder to a simple gastric debility which bitter tonics are especially adapted to cure. A very common ailment among persons who lead a sedentary life, even without an excessively close application to labor, and without an injudicious use of food, is sick headache. When the circumstances or the disinclination of the patient prevent him from employing the most effectual means of cure—a complete renunciation of his sedentary pursuits, and the adoption of vigorous and exciting exercise in the open air—he will find that the pure bitter tonics, with such regulation of his habits as may be possible, will be of more service in palliating his ailment than any other means whatever. Among these medicines quassia and colombo are the most useful in the cases referred to. When the attacks are periodical, the remedies should be used during one-half only of the interval between them, whether the first or the second half will depend upon the state of exhaustion following the attack, or of the gastric derangement which precedes it. In all of these cases other means may be necessary to remove particular

symptoms, as purgatives when there is constipation, alkalies when there is acidity of the stomach, and during the attacks stimulants and even narcotics; but a curative effect must be sought in bitter tonics, or in some analogous agency.

Bitter medicines are sometimes spoken of as possessing anthelmintic virtues; but this remark, with strict propriety, applies only to one or two of those which contain an essential oil. Simple bitters in general have no power of the sort except that which they may occasionally exert by increasing the vigor of the digestive organs, or, when taken in large doses, by their purgative effect. It is possible that quassia may, to some extent, be an exception to this statement, since, as mentioned elsewhere, there are numerous examples of its poisonous action upon insects, and even upon quadrupeds.

COLOMBA.—COLUMBO; CALUMBA.

DESCRIPTION.—Columbo is the root of *Cocculus palmatus* (De Candolle); *Menispermum palmatum* (Lamarck), a climbing plant of Mozambique, on the southeast coast of Africa. As found in commerce, it consists of transverse slices of the root, of a circular or oval shape, from half an inch to three inches in diameter, and from one to four lines in thickness. Its cortical portion is from one to three lines in thickness, and is separated by a dark line from the ligneous portion. The latter is of a greenish-yellow color, is arranged in several concentric layers, and is depressed in the centre, which is occupied by the shrunken medulla. It has a faint aromatic odor, and a very bitter and somewhat aromatic taste. The central portion is mucilaginous, and on account of the starch, which all parts of the root contain, it is readily attacked by insects, and its infusion rapidly undergoes fermentation. The taste, and probably the medicinal qualities of columbo, depend upon two proximate principles, *colombin* and *berberin*, the former of which is very slightly soluble in water or alcohol, but readily in acids and alkalies, while the latter is very soluble in alcohol, from which it is precipitated by water. From these facts, it follows that the active properties of columbo are not wholly extracted by a watery infusion. It contains neither tannic nor gallic acid. An infusion or tincture of galls gives a precipitate with an infusion of columbo, and when tincture of iodine is added to a decoction of the root, the presence of starch is revealed by the blue color which is produced.

ACTION.—No experiments besides the inconclusive ones of Percival have been made to illustrate the physiological action of this medicine. Our notions of its operation must therefore be drawn from its effects in disease. From these it may be inferred that columbo is a pure stimulant stomachic tonic, increasing the appetite, and improving the digestion. Owing to its containing no tannin, it does not tend to constipate the bowels, and doubtless the starch and gum which are so abundant in it contribute to prevent this effect.

USES.—Columbo was introduced into medical practice by Dr. Percival, who states that the inhabitants of the East Indies have for a long time used it in disorders of the stomach and bowels.¹ He also cites the testimony of a surgeon who long served in the East Indies to the effect that in *cholera morbus* it alleviates the tormina, checks the purging and vomiting, and speedily recruits the exhausted strength. Of his own knowledge, he states that it is serviceable in moderating the violence of the early symptoms of dysentery, but still more so as a cordial and tonic towards the decline of the attack. The same writer speaks of its beneficial effects when given with an equal or double quantity of sulphate of potassa, in the treatment of bilious fevers. But it was as a *stomachic tonic* that Percival especially recommended this medicine. He prescribed it for the *vomiting* and *purging* incident to the period of dentition, for habitual vomiting proceeding from weakness of the stomach, and in that which occurs during pregnancy; also in a languid state of the stomach attended with want of appetite, indigestion, nausea, and flatulence. If there was constipation, he associated it with rhubarb; and if the bile appeared to be defective, with inspissated ox-gall. Subsequent observation appears to have confirmed the opinion entertained of colombo by this eminent physician, and there is, at the present day, no medicine of its class which is more frequently or more successfully employed in repairing the loss of tone which, often accompanied with paroxysmal pain, affects the stomach of persons devoted to sedentary pursuits. In such cases an infusion may be employed with advantage which was recommended by Percival, and is made with an ounce of powdered colombo, half an ounce of orange-peel, two ounces of French brandy, and fourteen ounces of water. The whole should be macerated twelve hours without heat, and then filtered. If a decided laxative action should be required, the addition of a drachm of rhubarb, or two drachms of senna, may be made to the ingredients of the infusion. Although the use of colombo is very restricted in France, M. Trousseau is among

¹ Essay, Part I. p. 264.

those who have made use of it in the cases above described, and he speaks confidently of its virtues.

ADMINISTRATION.—The dose of the *powder* of columbo is from ten to thirty grains. In this form it may be usefully associated with carbonate of iron, with the addition of a small quantity of powdered ginger or orange-peel.

An *infusion*, which is officinal, is made by adding half an ounce of bruised columbo to a pint of boiling water. It should be macerated for two hours in a covered vessel and strained. The *dose* is a wine-glassful three or four times a day. The Edinburgh and Dublin Dispensatories direct that cold water should be employed. But spontaneous decomposition takes place in the cold infusion as readily as in the hot, produced in the former by albumen, and in the latter by starch. A cold infusion, made by displacement, is less liable to these changes; but they may be prevented altogether if the starch is first removed by cold water, and the albumen is afterwards coagulated by boiling the infusion.

The *tincture* of columbo may be used to increase the strength of the infusion, but it is never employed alone. It may also be added to effervescent medicines when given to check vomiting.

GENTIANA.—GENTIAN.

DESCRIPTION.—Gentian is the root of *Gentiana lutea*, a herbaceous, perennial plant, which is a native of the southern part of Middle Europe, where it grows in subalpine and mountainous meadows. It is two or three feet high, has a straight, smooth, hollow stem, pale green, opposite, ovate leaves, and large, yellow, pedunculated flowers in whorls. The root, as found in commerce, is in pieces of from several inches to one or two feet in length, of various thicknesses, single or branched, marked with annular wrinkles and longitudinal furrows. Its color is yellowish-brown externally, yellow internally, and the wood is of a spongy texture. It has a feeble, but unpleasant odor, and a very bitter taste. It yields its virtues to alcohol or water. These are supposed to depend chiefly upon *gentisin*, *gentianin* (the latter of which is the bitter principle), and also, to some extent, upon a *volatile oil*. It contains, besides, gum, sugar, mucilaginous matter or pectin, a fixed oil, &c., but neither tannic nor gallic acid. When the greater part of the bitter principle has been removed by alcohol, there remains behind a sweetish extract, which, by fermentation, produces a

sort of brandy. The Tyrolese peasants of the Styrian Alps prepare this liquor, which is called spirit of gentian (*Enziangeist*).¹

HISTORY.—Dioseorides first,² and Pliny after him,³ ascribe the first discovery of the virtues of this plant to Gentianus, King of Illyria, from whom also it derived its name. According to the former of these writers, it is stimulant and astringent, a powerful antidote to poisoning by venomous serpents, when taken with wine, pepper, and rue, and also a cure for pains in the bowels, and of bruises. Its root, used as a pessary, is declared to provoke abortion, and its powder or juice is recommended as a dressing for ill-conditioned sores, and as an application in squamous diseases of the skin. Galen declares it to possess attenuant and deobstruent qualities, which he ascribes to its bitterness. An Arabian writer alludes to a tree under the name of gentian, but states that the plant spoken of by Dioscorides is a shrub. Hobaiseh declares it to be an antidote to poisons that have been drunken, to the bites of serpents and scorpions, and venomous animals, and to the wounds inflicted by their teeth or claws. Above all, he adds, "it is that famous medicine whose virtues are so peculiar in cases of mad dog's bite." It is recommended to be given internally, and that its powder, moistened, should be applied to the wounded part.⁴

ACTION AND USES.—Gentian is a pure and simple bitter, with a very slightly stimulant property. In moderate doses it excites the appetite and strengthens the digestion, without tending to constipate the bowels. When long used, it gives to the sweat and the urine a bitter smell and taste, and is then apt to disorder the digestion, and in large doses to cause headache, with injection of the face, and fulness of the pulse. These effects are said to be most readily produced in feeble and sensitive persons, but are probably never observed except when the medicine is taken in excessive doses.

The affections in which gentian is most useful are those in which debility of digestion is the prominent symptom, whether this be caused by protracted illness from idiopathic fevers, by loss of blood, by exhausting suppuration, or by a sedentary life with undue occupation of the mind and a neglect of bodily exercise. It has had a considerable reputation in the treatment of gastric dyspepsia connected with a gouty diathesis, and especially with atonic gout. Boerhaave regarded it as a leading remedy in gout. It is one of the constituents of the *Portland Powder* which was famous as a specific in this disease, and which contained, besides, "birthwort (*Aristolochia rotunda*), the tops

¹ PFAFF, *System der Materia Medica*, ii. 28. ² Lib. iii. cap. 3.

³ Lib. xxv. cap. 34.

⁴ EBN BAITHAR, ed., *Sontheimer*, i. 260.

and leaves of germander (*Chamædrys*), ground pine (*Chamæpitys*), and lesser centaury (*Chironia centaurium*), in equal parts, powdered and mixed together."

Before the introduction of cinchona it was much used in *intermittent fever*, but, like other simple bitters, it appears to have been serviceable in those cases only which are complicated with atony of the digestive organs, or which assumed the lightest form of this disease, and especially in vernal intermittents. Like other vegetable bitters, it possesses some *vermifuge* properties, and may also be employed, like them, in the treatment of *scrofula*.

ADMINISTRATION.—Gentian may be administered in *powder*, in doses of from ten to thirty grains, but this is a most uneligible form.

The *compound infusion* (INFUSUM GENTIANÆ COMPOSITUM) is made with gentian, *half an ounce*, bruised orange peel and coriander seed, of each *a drachm*; diluted alcohol, *four fluidounces*; cold water, *twelve fluidounces*. The alcohol is added first, and in three hours afterwards the water; the ingredients are allowed to stand for twelve hours, when the infusion is strained. The dose of this, which is the best preparation of gentian, is a fluidounce repeated three or four times a day.

The *compound tincture* (TINCTURA GENTIANÆ COMPOSITA) is made with *two ounces* of gentian, *an ounce* of orange peel, *half an ounce* of bruised cardamom seeds, and *two pints* of diluted alcohol, which are allowed to macerate for fourteen days. This preparation is a very agreeable bitter and an efficient stomachic. It is peculiarly adapted to improve the tone of the stomach in persons worn out by habitual drunkenness and debauch. The dose is one or two fluidrachms.

Extract of gentian (EXTRACTUM GENTIANÆ) is prepared with water by displacement. In the dose of from ten to thirty grains it exhibits the peculiar properties of the root. It is, however, more generally used as an excipient for other tonic medicines, and particularly for iron and for quinia.

QUASSIA.

DESCRIPTION.—The wood referred to below was that of the *Quassia amara*, a small tree of Surinam; but the quassia of commerce is at present derived chiefly from *Q. excelsa*, a tall tree growing in Jamaica and other West India islands.

Quassia wood is generally found in billets, or in raspings or shavings. The first are sometimes a foot in diameter and several feet in

length, of a light porous texture, a yellowish-white color, and an intense and persistently bitter taste. It is without odor.

According to the chemical analyses that have been made of quassia, it contains various alkaline and earthy salts, gum, pectin, and quassin, a bitter principle on which its virtues are supposed to depend. Quassin forms white prismatic crystals, which do not change on exposure to the air, and have no odor, but are intensely bitter. It is soluble in alcohol, and partially so in water.

HISTORY.—Quassia wood and flowers are said to have been employed at least as early as the beginning of the eighteenth century by the inhabitants of Surinam, who held them in high esteem as stomatic medicines. The plant is stated to have derived its name from that of Quassi, a negro slave, who first made known its virtues to his master. This account is given by Rolander, who carried the wood to Stockholm in 1756. But the new drug did not acquire popularity until its botanical source was described by Linnæus in 1763.¹

ACTION. *On Animals*.—Bergius states that when flies drink of an infusion of quassia they appear benumbed and as if dead, but after a time recover their powers. It is said that the specimens of a botanical herbarium may be protected from insects by dipping the plants in an infusion of quassia, and then drying them, or by placing pieces of quassia wood among them. Even rabbits have been killed by a concentrated preparation of the drug. Härtel saw rabbits destroyed in three days after the application of one or two grains of extract of quassia to a wound in a fleshy part;² and Buchner, performing a similar experiment, in two instances found that death took place within thirty hours. Kurtz observed that a mangy dog, on being washed with a decoction of quassia, lost the use of his hinder limbs for the space of seven hours. Like other bitters, quassia is thought to retard animal decomposition.

On Man.—The intensely bitter taste of quassia has already been noticed. Its internal use excites the appetite, improves digestion, and promotes nutrition, at least when these functions are below the standard of health. But, like other bitter medicines, its excitant influence upon the stomach is not of long duration, and hence it should always be taken a short time before eating. If its use is continued for several weeks, it may occasion, at least where there is a constitutional tendency to plethora, a plethoric state of the system; but it gradually loses its tonic influence as the stomach becomes accustomed to its stimulus.

¹ BERGIUS, *Mat. Med.*, i. 354. Also, LETTEOM, *Mem. Med. Soc. Lond.*, i. 128.

² WILMER, *Wirkung*, &c., iv. 380.

It does not usually occasion either constipation or diarrhoea, but after a time is apt to produce gastric oppression and pain, with nausea, as all other local stimulants do when they are allowed to exhaust the susceptibility of the stomach. Giacomini, for whom and for the whole Rasorian school all tonics are sedatives, performed some experiments with quassia which strikingly illustrate the force of the imagination in therapeutics. Finding himself one day very weak in consequence of his having taken some infusion of quassia upon an empty stomach, he repeated the dose before eating; but this only made his condition worse. He experienced vertigo, dimness of vision, general debility, and feebleness of the pulse, and was obliged to partake of food to renew his strength. On the other hand, feeling oppressed, dull, and disgusted after a full meal, by, as he says, the excessive stimulus of the food, quassia restored his feelings of comfort by reducing the over-stimulation.¹ Scarcely anywhere else than among the writers of the Rasorian school can so singular and perverse a misinterpretation of facts be found.

USES.—The history of the first introduction of quassia into medical practice shows that it was highly esteemed in the treatment of *intermittent fevers* by the inhabitants of Surinam. Even Linnæus asserted that in this respect it far excelled cinchona, and not a few of his contemporaries avowed the same belief. Lettsom, who, very justly, criticized this opinion, nevertheless admits that in some rare cases it will cure the disease when bark has failed to do so. In truth, it possesses as much, and no more, efficacy in this affection than gentian, boneset, chamomile, absinth, &c.—that is to say, the power of curing mild attacks, especially of vernal intermittents.

But it is as a *tonic* and *stomachic* bitter that quassia was first employed, and continues to enjoy a deserved reputation. Whenever the stomach has lost its natural tone after attacks of acute disease, or in consequence of general indolent habits, or, on the other hand, from a want of wholesome, abundant, and appetizing food, or from excessive losses of natural or morbid secretions, quassia is equal, if not superior, to any medicines of its class in reviving the dormant appetite and strengthening the languid digestive powers. In that form of dyspepsia in which vomiting is a frequent occurrence, this medicine will be found peculiarly serviceable, provided that the symptom does not depend upon a textural disease of the stomach. This remark applies not only to simple regurgitation of the food, but also to bilious vomiting with headache, or sick headache, as it is called. In many cases of atonic

¹ Mat. Méd., par Mojon, &c., p. 482.

diarrhoea, and of that form which depends upon the irritation of the colon by retained faeces, the medicine is very serviceable.

Tode speaks of its use in cases of gastric atony attended with spasm of the oesophagus; and Schleger refers to its usefulness in certain cases of vertigo with spastic muscular spasm of the neck, oppressive pain in the head and ringing in the ears.¹ In an affection somewhat analogous to the latter, described by Bretonneau as depending upon gastric acidity, and marked with vertigo, and a tendency to syncope with sour eructations, quassia with bicarbonate of soda has been found of signal advantage.² The same may be said of other more evidently nervous or hysterical affections complicated with dyspepsia or depending upon it.

Some of the older writers, among whom Tissot may be mentioned, attribute *anthelmintic* virtues to quassia; and, more recently, Dr. Schultz speaks in praise of its infusion as an injection for the removal of ascarides of the rectum.³ In the latter case it acts by directly destroying these parasites.

ADMINISTRATION.—Quassia is seldom administered in substance on account of its extreme bitterness. The dose of the *powder* is, however, twenty or thirty grains.

The *infusion* (INFUSUM QUASSIÆ) is made with two drachms of quassia to a pint of water. The hot infusion is the stronger, but is more disagreeable than that made with cold water. Quassia cups, or cups turned from quassia wood, have recently been introduced into this country. They are filled with water over night, and their contents drunk in the morning. This invention may be called a medical toy, well adapted to amuse childish patients.

The *extract* (EXTRACTUM QUASSIÆ) is prepared with water, and is a very efficient preparation; but is better suited for combining with iron, or with laxatives, which should be given in small doses, than for separate use. It may be prescribed in pilular form, or dissolved in Sherry or Malaga wine. The dose of the extract is from two to five grains.

The *tincture* (TINCTURA QUASSIÆ) is occasionally called for in low fevers, or during convalescence from acute diseases, but it is seldom used except as an addition to the infusion or decoction of quassia, or of some other bitter tonic. The dose is one or two fluidrachms three or four times a day.

¹ MURRAY, Appar. Med., iv. 449.

² TROUSSEAU and PIDOUX, op. cit., 5ème éd., i. 732, and ii. 380.

³ Amer. Journ. of Med. Sci., June, 1847, p. 175.

SIMARUBA.

DESCRIPTION.—Simaruba is the bark of the root of *Quassia simaruba* (Linn.), *Simaruba officinalis* (De Cand.), a tall forest tree of Guiana and Jamaica. In commerce it occurs in long fibrous pieces, rough, and of a grayish color externally, and of a pale yellow or yellowish-white within. It is inodorous, and has a very bitter and somewhat mucilaginous taste. Its bitterness appears to depend upon quassin, the same principle that exists in *quassia excelsa*; but unlike that drug, it contains gallic acid and tannin, and also, according to Pfaff, much mucilage. The differences of composition may explain, in part, the differences in the curative operation of the two medicines. But it is also said by Desbois and by Bichat, to be emetic in large doses; and Buchner states that its alcoholic extract has narcotic properties.

HISTORY.—The virtues of Simaruba bark were learned from the aborigines of Cayenne, with whom it was reputed to be a remedy for bowel complaints and hemorrhages. It was first carried to Europe in 1713, and a few years afterwards was employed in an epidemic of dysentery with great success by Barrère and Jussieu, and the latter wrote an account of it which gave the medicine great reputation.

Its vogue was still further extended by the favorable opinion of many eminent physicians, among whom were Schwencke, Tissot, Pringle, Werlhof, Zimmerman, Lind, Brocklesby,¹ and O'Brien.² It has, nevertheless, now fallen comparatively into disuse.

USES.—As already stated, Simaruba was used by the natives of Guiana, as a remedy for derangements of the bowels. Jussieu proclaimed it to be most effectual in *chronic dysentery and diarrhœa* which had resisted other modes of treatment, particularly when the stools were by turns bloody, mucous, and bilious. According to him, and to most of the authors named above, after a few doses of the medicine the pain is assuaged, sleep and a desire for food return, the fetor of the stools and their frequency diminish, their color and consistence become more natural. These effects are stated to begin within three days after the first administration of the medicine, and without occasioning nausea or other annoyance if a proper dose is given. So long as tenesmus and fever of a sthenic type are present,

¹ MURRAY, Appar. Med., iv. 457.

² In 1828, Dr. Wright found that in the epidemic dysentery, which then prevailed in Ireland, Simaruba bark possessed "considerable astringent powers, and that when united with opium, it is an anti-dysenteric of no mean efficacy."—*Trans. of the College of Physicians in Ireland*, v. 237.

simaruba and all other tonics would be manifestly injurious, but when once these have declined, or when, from the commencement, the disease presents asthenic symptoms, it is probable that it will be serviceable, especially if the bowels are previously cleansed. How far simaruba may be preferable to other medicines of its class, in the treatment of dysentery (and they have all been used for this purpose), it is difficult to determine; but as it contains a simple bitter principle, united with a pure astringent and a demulcent, it would seem to have a support for the claims which so many competent judges have decided in its favor.

The other uses of simaruba are the same as those of quassia. The only officinal preparation of this medicine is the *infusion* (INFUSUM SIMARUBÆ), which is made by adding a pint of boiling water to two drachms of the bruised bark. The dose is two fluidounces.

SABBATIA.—AMERICAN CENTAURY.

DESCRIPTION.—This is the herb and root of *Sabbatia angularis*, a native annual or biennial plant of the United States. The stem, which is one or two feet high, is smooth and four-sided, with opposite branches, and terminating in numerous flowers forming together a corymb. The flowers are of a rich rose-color above, but pale in the centre and beneath.

The whole plant is very bitter, but without smell; it yields its virtues to alcohol and water.

USES.—Centaurry may be prescribed in all of the cases for which simple bitters have been recommended in the preceding articles, but it is one of the least efficient of its class. As a popular remedy in intermittent fever its cold infusion has been extensively used in rural districts, but it is too feeble to produce curative effects, except in very mild cases. The hot infusion is sometimes used as a diaphoretic at the commencement of acute febrile attacks. As a tonic it is appropriate during the convalescence from sickness, and in slight cases of atonic dyspepsia.

ADMINISTRATION.—The dose of the *powder* is stated to be from *thirty grains* to a *drachm*. It is commonly given in an *infusion* made with an ounce of the plant to a pint of boiling water. Of this a wine-glassful, or more, may be directed as a febrifuge every two hours, and as a tonic three times a day.

CENTAURIUM.—EUROPEAN CENTAURY.

The herb or tops of *Chironia centaurium* (*Erythræa centaurium*), or centaury, as the plant is called in England, were anciently used in medicine as a vulnerary, in chronic pulmonary affections, in gout, in diseases of the liver, and in jaundice, and also as a vermifuge; but it is now seldom employed except as a domestic remedy in Europe, and hardly ever in this country.

According to Moretti, it contains mucus, extractive salts, and a bitter principle, which Dulong supposed that he isolated, and which he called *centaurin*; and Buchner detected in it also an essential oil of powerful odor, and which, taken internally, in doses of fifteen or twenty drops, acts as an arterial stimulant. The medicinal operation of European centaury appears to be that of a stimulant tonic, and it is therefore used in gastric debility, atonic diarrhoea, mild cases of periodical fever, and even in dropsy. Externally, its decoction is employed as a wash for indolent ulcers, and also to destroy lice.

In Germany the expressed juice of the plant is prescribed in doses of half a fluidounce, and a decoction is made with half an ounce of the dried plant to a pint of water, reduced slowly to eight ounces.

CHIRETTA.

DESCRIPTION.—Chiretta, or Chirayta, consists of the small stalks and root of *Agathotes chirayta* (Don), *Gentiana chirayta* (Roxb.), a native herbaceous plant of the mountains westward of the Ganges, in Hindostan. The whole plant is intensely but not disagreeably bitter, and has no odor. According to the analysis of MM. Lassaigue and Boissel, it contains, besides various salts and gum, a resin and a yellow bitter matter, upon which last its virtues are presumed to depend.

USES.—The natives of Hindostan hold this medicine to be tonic, stomachic, and febrifuge,¹ and Mr. Twining recommends an infusion of it as a vehicle for the arsenical solution in intermittent fever.² According to Mr. Baker it is a “deobstruent” as well as a stomachic medicine, increasing the biliary secretion, and clearing the complexion in jaundiced persons. In scrofula he frequently witnessed its salutary influence.³ The native practitioners hold it to be a remedy for consumption. Perhaps this opinion may arise from its utility in

¹ AINSLIE, Mat. Indica, ii. 373.

² Diseases of Bengal, 2d ed., ii. 218.

³ Lond. Med. Gaz., ii. 685.

chronic bronchitis, which is attested by Mr. Houlton, in a case where the expectoration was very great, and the powers of the system very low. He used an infusion prepared with half a drachm (3ss?) of chiretta to a pint of water.¹

ADMINISTRATION.—In *powder* the dose of chiretta is twenty grains. An *infusion* may be made with half an ounce of the root to a pint of boiling water; after standing for two hours it should be strained. It may be given in the dose of from one to three ounces before dinner. Mr. Baker, above cited, states that the natives of Hindostan prefer the *decoction* to the infusion, and make it by gently boiling half an ounce of the dried cut herb in a pint of water for about twenty minutes. Of this decoction the dose is a small wineglassful two or three times a day. The same writer states that the extract of chiretta preserves its virtues perfectly. A *tincture* is prepared according to the Dublin Pharmacopœia by macerating five ounces of bruised chiretta in two pints of proof spirit for fourteen days. The dose is from one to two fluidrachms.

COPTIS.—GOLDTHREAD.

DESCRIPTION.—The root of *Coptis trifolia*, a small evergreen plant with a slender, creeping root, of a bright yellow color, from which its popular name is derived. It inhabits the northern regions of Asia and America, and abounds upon the hills of New England. All parts of the plants are bitter, but the root is intensely so. It is without astringency.

USES.—Coptis has no special virtues beyond those of the other simple bitters to recommend it, but in case of need might be substituted for them. In New England it is popularly used in a wash for aphthous sore mouth, but there is no evidence of its special virtues in this complaint.

An *infusion* may be made with an ounce of the root to a pint of water; and a *tincture* with similar proportions, but substituting alcohol for water. Of the former the *dose* is an ounce, and of the latter a fluidrachm.

XANTHORRHIZA.—YELLOW-ROOT.

DESCRIPTION.—The root of *Xanthorrhiza apiifolia*, a small native shrub of the southern part of the U. States. Its slender stem has a

¹ Med.-Chir. Rev., xxxvii. 205.

smooth bark covering a bright yellow wood, and it bears dark purple flowers in pendulous racemes. Its coloring matter was made use of by the aborigines as a dye. It imparts a drab color to wool, and a rich yellow to silk. The bark of the stem possesses the same qualities as the root, which appear to depend upon a bitter gum and resin.

USES.—Yellow-root is regarded as a simple tonic bitter, and as applicable to the same disorders as the other medicines of its class. It may be used in *substance* in the dose of one or two scruples; it may also be given in tincture or in decoction, but alcohol is supposed to extract its virtues more perfectly than water.

STIMULANT TONICS.

MEDICINES belonging to this subdivision are distinguished by possessing a certain degree of stimulant as well as a tonic power, the latter depending upon a fixed bitter principle, the former on an essential or volatile oil. In virtue of these constituents, they have also a double action, the one of which is identical with that of pure bitters, and is manifested by their improving the digestion when given in moderate doses, and by their acting as emeto-cathartics when largely administered, especially in the form of warm infusion. The other, due to their essential oil, displays its action upon the nervous system, and through it upon the circulatory and muscular apparatus, especially of organic life, and primarily of the abdominal organs, increasing the contractile power of the stomach and bowels, and augmenting the secretion from the kidneys and the exhalation of menstrual blood from the uterus.

In practice, stimulant tonics are not, like simple tonics, adapted to a prolonged and almost habitual use. Their excitant element is transient in its operation, and their tonic element is comparatively feeble; hence the exhaustion which follows the action of the former is not fully compensated for by the supporting influence of the latter. It is true that all are not alike in these respects, and that in some the tonic quality predominates, while others are little more than stimulants. Indeed, if we review the diseases in which these medicines are reputed to be most beneficial, we shall find them to be such as call for the application of temporary stimulation rather than permanent strength. Thus, in dyspepsia, they are useful chiefly to prepare the way for the

more sustained and vigorous operation of pure bitters, or to relieve some special symptoms, such as flatulence or nausea, in cases for which pure stimulants appear to be too exciting. Or if we refer to the other affections in which they are employed, we shall find that, as a rule, the stimulant element of their action is the one upon which their curative operation chiefly depends. This is the case in spasmodic flatulent colic, in suppression or scanty discharge of the menses, and in hæmorrhoids. It is equally so in the treatment of influenza and other forms of bronchitis, acute or chronic, when these medicines become curative. Still more evident is it in those affections which are not seated in a particular organ, but affect the whole system in one or more of its elements. Thus, in nervous debility, that is, exhaustion with great excitability of the nervous system, stimulant tonics precisely meet the requirements of the disease; in intermittent fever, in commencing or in chronic rheumatism, in the typhoid state, &c., the tonic element of the treatment is quite subordinate to the stimulant one. This latter is the essential agency, and the tonic influence is of value chiefly because it heightens and sustains the other.

ANTHEMIS.—CHAMOMILE.

DESCRIPTION.—Chamomile, the flowers of *Anthemis nobilis*, a native plant of Italy, France, and Spain, but cultivated also in this country, and especially in England, whence it enters largely into commerce. It is a small herb with pinnately-divided pale-green leaves, and flowers with a convex, bright-yellow disk, surrounded by numerous white rays (florets), which become more numerous by cultivation, and gradually usurp the place of the yellow florets of the disk.

Chamomile-flowers have a strong and peculiar odor, whence, indeed, they are said to have derived their name (*χαμαίμηλον*, apple-scented herb), and a bitter and aromatic taste. Water and alcohol extract their virtues. They contain, besides salts of lime and potash, a peculiar bitter principle, resin, and a volatile oil from which they derive their odor, and upon which some of their peculiar virtues depend. It is of a light-green color, which is lost by rectification, and has the peculiar odor of the flowers in a high degree. German chamomile (*Matricaria chamomilla*) furnishes in a larger, indeed, in nearly double the proportion of the English flowers, a dense, dark-blue, and almost opaque essential oil, which becomes transparent by rectification, but has a less agreeable odor than that obtained from the other plant.

HISTORY.—This medicine has been employed from ancient times.

The chamomile of Dioscorides and Galen (*ἀνθεμῖς*) is supposed by many to be *Matricaria chamomilla*, L., which is now used almost as exclusively in Germany as the officinal chamomile, *Anthemis nobilis*, L., is in England and France. Except that the latter is the more active medicine of the two, they may be considered as possessing the same remedial operation.

Among ancient writers, Dioscorides is the first who describes the characters and qualities of chamomile. He speaks of three species, differing only in their flowers. These, with the root and leaves, he pronounces calcfacient and attenuant, and states that internally, or applied externally as a fomentation, they promote the discharge of the menses, of the foetus and the urinary secretion, and the expulsion of calculi; that they are drunk for flatulence, colic, iliac passion, jaundice, and liver complaints, and that their decoction is singularly beneficial as a fomentation in affections of the bladder. In a cataplasm, chamomile-flowers, he says, cure lachrymal fistulæ, and, when chewed, heal ulcers of the mouth. They are also used in clysters with oil, and *in powder as an anti-periodic*.¹ According to Galen, chamomile is peculiarly appropriate for the relief of debility, for alleviating pain, allaying phlegmonous inflammation, mollifying hardened parts, and resolving fevers unattended with inflammation of the internal organs, &c. Nichessor, the Egyptian, says that oil in which chamomile-flowers have been bruised when used to anoint the whole body of a person attacked with fever will excite perspiration if the patient is kept well covered in bed.² The Arabian writers repeat this description without many additions, but allude to the essential oil as possessing anodyne qualities, and to the use of the vapors from a hot decoction as useful in the decline of rheumatism.

ACTION.—The essential oil and the bitter principle of chamomile represent its action on the system. It is a stimulant and tonic. In substance or strong infusion it produces a sense of warmth in the stomach, and, it is said, some acceleration of the pulse. It expels flatus, improves the digestion, does not confine the bowels, and is alleged even to possess emmenagogue virtues. In large doses it occasions nausea, vomiting, looseness of the bowels, pain, with fulness of the head, and it is even said in certain idiosyncrasies to produce a sort of somnolent intoxication with general depression and exhaustion. (*Giacomini*.)

USES.—At the present day chamomile is chiefly used to improve the *digestive* function when it has become disordered by general disease,

¹ Lib. iii. cap. cxxvii.

² MATTHIOLUS, Comment.

or by any of the causes that tend to impair its vigor. It is indicated when the process of digestion is rendered difficult and painful by flatulent colic, and more particularly in females and other persons of a nervous temperament. It is one of the best remedies of the tonic class used to prevent the returns of sick headache, although, like all the rest, it often fails in this painful and tenacious ailment. Portal has reported a case of long-continued vomiting of black matter, in which an infusion of chamomile and lime-water were used with striking success. Chamomile has also been found to relieve the spasmodic abdominal pains that accompany general susceptibility to cold and also the menstrual period when the discharge is scanty and light colored. The emmenagogue virtues of chamomile are asserted by Dr. T. H. Brown.¹ They are insisted upon by Giacomini. Forestus speaks of the efficacy of the plant in relieving after-pains, and Murray says that chamomile tea is a well-known domestic remedy for this symptom. In *neuralgia* of the fifth nerve, according to Dr. Leconte, it will sometimes effect a cure when quinia has failed. He reports several cases which appear to sustain his good opinion of chamomile, and insists upon the necessity of giving it in substance and in drachm doses, or in a very concentrated infusion.²

In *intermittent fever* Morton asserted that powdered chamomile in proper doses and at sufficient intervals was not inferior to Peruvian bark. He, however, combined it with antimonial powder and salt of wormwood;³ Piteairn and Hoffmann were of the same opinion, but Cullen, in citing it, states that if the flowers are given in large quantity they run off by stool, and defeat the purpose of administering them.⁴ Voigtel says that in those forms of intermittent fever which are only founded in atony and congestion of the abdominal organs and require for their removal volatile as well as permanent stimulants, and which therefore are not cured by cinchona, chamomile is one of the most efficient remedies.⁵ So Fr. Dubois states that he cured a tertian ague, which had resisted sulphate of quinia for three months, by daily doses of a drachm of powdered chamomile. He also cites Wauters, Bodart, Chaumeton, and Masius as having been equally successful.⁶ It is, indeed, asserted⁷ that this remedy is inefficient in the treatment of miasmatic intermittents, but it is simply begging the question to presume that all who have vaunted

¹ Am. Journ. of Med. Sci., July, 1855, p. 268.

² Bull. de Thérap., xlvii. 556.

³ MURRAY, App. Med., i. 215.

⁴ Mat. Med., ii. 78.

⁵ Syst. der Arzneim., iii. 432.

⁶ Mat. Méd. Indigène, p. 126.

⁷ TROUSSEAU and PIDOUX, op. cit., 5ème éd., ii. 489.

chamomile as a remedy for intermittent fever from the time of Dioscorides to the present day, have been mistaken in regard to the nature of the disease which they cured. It has been stated elsewhere that many cases of simple intermittent fever, especially of the vernal form, recover under the influence of good nursing or a change of air alone. Many of these, it is to be presumed, recover still more rapidly if treated by chamomile or by any stimulant bitter; but there still remain not a few cases, like some cited above, in which chamomile cures after bark has failed to do so, and in these it is impossible to deny that the former medicine has accomplished what the latter could not perform. If it is said, as it has been, that these are cases of an idiosyncrasy rebellious to bark, the fact must be admitted, and it does not disprove, but rather it establishes, the anti-periodic virtue claimed for chamomile.

It is probably not a matter of indifference in what form the remedy is administered. In all of the cases referred to above the powder was exclusively employed. Sometimes it is given in the form of hot infusion upon the approach of the paroxysm, and in such a manner as to promote diaphoresis; or again, when there is gastric or bilious derangement copious draughts of warm chamomile tea may be directed so as to induce copious vomiting followed by perspiration. But in both of these cases whatever there may be specific in the medicine is not brought into operation.

The *emetic* properties of chamomile, one of the applications of which has just been referred to, may be invoked whenever it is desirable to evacuate the stomach without depressing the system, as in cases of so-called biliousness, when the stomach is over-loaded with food, and also after a debauch, or at the commencement of an attack of *mania-a-potu*. The warm infusion is also an excellent drink to be given after the more active emetics, or with them, in order to render their operation more prompt and certain.

Externally the *oil* of chamomile has been applied by friction to painful rheumatic parts, and to the abdomen when distended with flatus. It has also been applied to the auditory canal for the relief of earache. But more commonly fomentations made with chamomile flowers soaked in hot water or an alcoholic liquor, or poultices of flax-seed meal made with a strong infusion of chamomile, are used to assuage local pain arising from intestinal or uterine colic, rheumatism, neuralgia, earache, toothache, abscess, &c., or to cleanse foul and gangrenous sores.

ADMINISTRATION.—In the form of *powder* chamomile may be prescribed in doses of twenty grains three times a day as a tonic, and as an anti-periodic, in doses of a drachm at like intervals.

The *infusion* (INFUSUM ANTHEMIDIS) is made with half an ounce of chamomile to a pint of water. The cold infusion is more agreeable than that made with hot water, but is also less efficient. The dose is a wineglassful or two before meals. As an emetic not less than a pint of the warm infusion should be prescribed.

The *extract* (EXTRACTUM ANTHEMIDIS, *Ed.*) possesses none of the volatile oil of the flowers, and does not therefore fully represent them as a medicine. It is, however, a good bitter tonic in the dose of from five to twenty grains. In preparing pills with this substance, a small quantity of the oil of chamomile may be added, for the purpose of rendering them more efficient.

The *oil* of chamomile (OLEUM ANTHEMIDIS, *Lond.*) is sometimes prescribed as a stimulant carminative, in doses of five or six drops, upon sugar, in ether, or in Hoffmann's anodyne, or in pills made with crumb of bread.

EUPATORIUM.—THOROUGHWORT; BONESET.

DESCRIPTION.—The leaves and flowering tops of *Eupatorium perforatum*. This is an indigenous, perennial, herbaceous plant, which abounds in every part of the United States, usually growing by the margins of small streams. The stems are erect, and branched above; the leaves, which are long and narrow, are opposite, and united at their bases so as to appear perforated by the stem, whence the specific name of the plant, *perforatum*. The adjacent pairs are in parallel planes, but are at right angles to one another. The flowers are white and feathery, and are arranged in dense terminal corymbs.

The virtues of eupatorium appear to reside in its leaves and flowers, which are of a very bitter but peculiar taste. They are yielded to water and to alcohol. An attempt was made in 1813 to determine upon what principles the sensible qualities of the plant depend, by Dr. A. Anderson, of New York. In his inaugural thesis he endeavored to show that it contains tannin, resin, gum, &c.,¹ and one or two other examinations have been made with equally imperfect results. One of them, however, appears to have proved that it contains an essential oil in small proportion.

ACTION AND USES.—Eupatorium is closely analogous to chamomile in its effects, a stimulant tonic in small quantities, a laxative in large doses, and an emetic and diaphoretic when administered copiously in

¹ An Inaugural Dissertation on the Eupatorium Perfoliatum of Linnæus, p. 49.

warm infusion. Its diaphoretic action is, indeed, conspicuous in many circumstances. It was first brought into notice by the aborigines of this country, who are said to have employed it in *intermittent fever*. In 1803 it was known to be popularly used for the cure of this affection,¹ and its use in *yellow fever* advocated by Mr. Stevens, and even by Dr. Hosack.² Their hopes in regard to it proved unfounded. In intermittent fever it was and continues to be a popular domestic remedy. Dr. Anderson published six cases of its successful use, and was of opinion that it might supersede Peruvian bark and other ordinary remedies. But subsequent observation has greatly narrowed the grounds of its reputation, and the general sentiment is now in accordance with that of Eberle, who says: "The result of my own experience does not lead me to form a very high opinion of it as a remedy in intermittents. I have known it to remove the disease in a few instances by producing vomiting and copious perspiration."³ Administered in this manner on the accession of the paroxysm, in vernal intermittents especially, and during the apyrexia in the form of cold infusion, it will doubtless generally cure them. In mild cases of autumnal intermittent, occurring remote from a focus of malaria, it may also sometimes succeed, as well as in cases which have proved intractable to quinia. Like others of its class, however, eupatorium must hold a very humble place among the anti-periodic medicines.

It is much more useful in the treatment of acute muscular *rheumatism*, and of epidemic catarrh, or *influenza*. Its diaphoretic virtues are sufficient to put an end to an attack of the former disease, if given at an early stage; and probably the tonic influence of the cold infusion would, like that of cinchona and other bitters, promote the return of health. The utility of the medicine in influenza is thought to have been early recognized, and its popular name of *boneset* was perhaps acquired by its relieving the distressing "pains in the bones" which distinguish this disease. It was more probably, however, given in consequence of its beneficial effects in the cold stage of intermittent fever, when such pains are often extremely severe. However this may be, it is stated by Anderson to have proved highly serviceable in the influenza of 1807. In an epidemic at Petersburg, Va., in 1843, Dr. Peebles employed it with very satisfactory results.⁴ The pain in the back and limbs, and the lassitude of the general muscular system, subsided as soon as the system was placed under its influence; it in-

¹ STEVENS, Med. Repository, vii. 12.

² Med. Essays, iii. 434.

³ Mat. Med., 6th. ed., p. 463.

⁴ Am. Journ. of the Med. Sci., April, 1844, p. 362.

duced a healthy and free discharge of perspiration, restoring the natural color and tone of the skin, and at the same time allayed the cough, promoted expectoration, and removed dyspnoea. The patient having been covered up in bed, a warm infusion of the medicine was given in wineglassful doses every half hour. After the fourth or fifth dose considerable nausea, sometimes vomiting, with free diaphoresis and expectoration, ensued, and there was an immediate amelioration of the symptoms. From this time, unless there was a relapse, the medicine was given only every third hour, in the same dose. Generally on the fourth day the patient was able to go out. During convalescence a wineglassful of the cold infusion was given three times a day.

In the "typhoid pneumonia" which prevailed from 1812 to 1814 it is said to have been salutary; and more recently it has been "extensively employed among the negroes on the plantations in South Carolina as a tonic and diaphoretic in colds and fevers, and in the typhoid pneumonia so prevalent among them."¹

As a *tonic*, eupatorium is not as acceptable to the stomach as chamomile, yet its cold infusion may be used for all the purposes for which medicines of its class are prescribed. Dr. Bigelow speaks favorably of it, saying that it "promotes digestion, strengthens the viscera, and restores tone to the system." Dr. Eberle thought it peculiarly adapted to the relief of indigestion in very old people; and Dr. Burgon used, with evident benefit, the cold infusion "in cases of anorexia consequent to drunkenness."

ADMINISTRATION.—Eupatorium is seldom exhibited in *substance*, but the dose of the powder may be stated at twenty or thirty grains.

The *infusion* (INFUSUM EUPATORII) is the usual form in which eupatorium is administered. It is prepared from an ounce of the herb in a pint of water. Of this, the dose as a tonic, is one or two fluidounces taken cold, three or four times a day; but more frequently as an anti-periodic. As an emetic, the infusion should be given warm in doses of half a pint; and as a diaphoretic, in doses of a fluidounce or two every half hour until nausea occurs, or the proposed effect is induced.

ANGUSTURA.—ANGUSTURA BARK.

DESCRIPTION.—The bark of *Galipaea cusparia*, a tall forest tree of South America, and probably also of *G. officinalis*, a small tree of the

¹ Dr. F. P. PORCHER, Trans. Am. Med. Assoc., ii. 791.

same region. In commerce it occurs in quills, and in flat pieces covered with a soft epidermis of a grayish white or yellow color. The internal surface is brownish yellow, fibrous, and laminated. It has a peculiar and somewhat offensive odor, and a bitter, somewhat aromatic, and persistently acrid taste which excites salivation. Powder of Angustura resembles that of rhubarb in color.

There is contained in this bark a bitter crystallizable principle, *cusparin*, with a *bitter hard resin*, a *balsamic soft resin*, *volatile oil*, *gum*, and *woody fibre*. It yields its properties to alcohol and water.

A bark closely resembling this, and sometimes found mixed with it in commerce, is known as *false Angustura*. It is that of *strychnos nuxvomica*, and is intensely poisonous. The leading differences between it and true Angustura bark are these: its quills or flat pieces are twisted, its epidermis is of a rust color, it is not laminated, emits but little odor, has a persistently bitter taste, and its powder is of a very pale yellow color.

HISTORY.—In 1759, Mutis published at Madrid, that Angustura bark was used by the inhabitants of the Spanish colonies with great success as a remedy for fever and dysentery. It was brought to England in 1788, where for some time it was held in great esteem. But in 1804 numerous cases of poisoning having occurred with symptoms like those produced by strychnia, and which were traced to the admixture of the bark of the *nux vomica* tree with the true Angustura, the latter fell into disrepute, and has ever since been but little employed even in Europe, and still less in the United States. Nevertheless, it possesses qualities which seem to entitle it to favor as a medicine.

ACTION.—Angustura bark is held to resemble cascarilla in its operation, but it is less stimulating, and is more analogous to the pure bitters. If the stomach is irritable, it is apt to occasion nausea and vomiting. It is sometimes compared to cinchona, but it has less astringency.

USES.—Like the other bitters, it has been used very successfully in many cases of *intermittent fever* of a mild type; and Winterbottom declared it equally efficacious with cinchona in the treatment of *remittent fever* at Sierra Leone, and even preferable as a tonic towards the decline of the attack. He also used it with advantage for the cure of intermittents.¹ Hancock, Williams, and Wilkinson have also spoken of it favorably. M. Bretonneau, on the other hand, found it

¹ Med. Facts and Obs., vii. 41.

wholly insufficient for the cure of cases presenting a regular type and of several weeks' duration.

In *low fevers* it has been usefully employed under the same circumstances as Peruvian bark, particularly in those attended with diarrhœa, great debility, and adynamic symptoms generally. Under such circumstances, Lettsom thought it superior both to cinchona and serpen-taria.¹ When these symptoms characterize *epidemic dysentery*, the medicine appears to have been employed with marked advantage by the natives of Angustura, and especially in the typhoid and chronic cases of this affection.

In ordinary cases of asthenic *dyspepsia*, especially those in which flatulence predominates, it has been found of service.

ADMINISTRATION.—Angustura bark may be given in powder, in doses of from ten to thirty grains. The *infusion* (INFUSUM ANGUSTURÆ) is made with half an ounce of the bark to a pint of boiling water, and may be given in the dose of two fluidounces.

CASCARILLA.

DESCRIPTION.—Cascarilla is the bark of *Croton eleuteria*, a small tree which is a native of the Bahama Islands and Jamaica. In commerce it generally occurs in quills, or in pieces from one to four inches long, and half an inch or less in diameter. It is hard and heavy, with a resinous fracture; the epidermis is whitish, from being covered with lichens, and irregularly fissured, and the true bark is of a dark-brown color. Its taste is bitter, warm, and spicy, and its smell, when it is warmed, is aromatic, and when burned, very much like that of musk.

Alcohol and also water extract its virtues, which are supposed to depend upon a volatile oil and a bitter resin, and bitter extractive matter. It does not contain any astringent principle.

HISTORY.—Cascarilla (a diminutive of the Spanish word *cascara*, and meaning little bark), according to Pomet was brought to France from South America, in 1670,² by M. Legras; and in 1684, Stisser described its aromatic taste and smell, and referred to its being frequently mixed with Peruvian bark.³ This same Stisser published a book in the year 1693, in which he states that a portion of the bark had been given him by an Englishman of some celebrity, and that he had made tinctures of it, and tried its medicinal powers in calculous affec-

¹ Mem. Med. Soc. Lond., iv. 193.

² Hist. des Drogues, Appendix à la 3ème partie.

³ HOFFMANN, Oper. Om. suppl., ii. 705.

tions, in asthma, phthisis, and scurvy; that he had reason to be satisfied with his success, and adjudged it to be diuretic and earminative.¹ At that time it was much used to mix with smoking tobacco, to which it imparted an aromatic fragrance and taste, and as a medicine in intermittent, hectic, and malignant fevers, dysentery, and flatulence of the bowels.

ACTION AND USES.—The properties of cascarilla are stimulant rather than tonic, and its fumes when inhaled have a very sensibly intoxicating effect. The infusion excites a pleasurable feeling of warmth in the stomach, but in a large quantity occasions nausea, colic, and diarrhoea.

It was originally given in *intermittent fever* associated with *cinchona*, for the purpose of correcting the astringent operation of the latter, while it appeared to enhance its febrifuge powers. It was also used to render the bark more acceptable to the stomach. Like other bitters, it sometimes has cured intermittents of a mild type. Its more frequent use, however, was to produce a stimulant effect in *low fevers* and *dysentery* of the same type, or of the chronic form, when they prevailed epidemically. It was then either given alone or as an adjuvant to cinchona. Its use in such affections is perhaps too much neglected at the present day, when it is seldom prescribed except as a stomachic stimulant tonic in cases of *atonic dyspepsia* attended with flatulence, or with frequent vomiting of the food, either alone or associated with other medicines of the same class.

ADMINISTRATION.—The dose of cascarilla in *powder* is from ten to thirty grains. The *infusion* (INFUSUM CASCARILLÆ) is made with an ounce of the bruised bark to a pint of boiling water, and may be given in doses of two fluidounces, two or three times a day.

MARRUBIUM.—HOREHOUND.

DESCRIPTION.—Horehound (*Marrubium vulgare*) is a perennial herbaceous plant, which grows in Europe in hilly and stony localities, and by roadsides. It is fully naturalized in this country. It is remarkable for its white cottony stalk and leaves, its aromatic and somewhat musky smell, and its bitter and spicy taste. It contains a bitter extractive with an essential oil, some resin, and a little tannic acid, and yields its virtues to water and alcohol. The herb is used in medicine.

¹ SIGMOND, *Lancet*, 1837-38, i. 575.

HISTORY.—Dioscorides gives a full account of this plant, whose leaves or juice, he says, are, when taken with honey, very serviceable to those who have asthma, cough, or consumption, it being eminently efficient as an expectorant. He states that it promotes the discharge of the placenta and of the lochia, favors conception, and is an antidote to the bite of venomous serpents, but that it irritates the kidneys and bladder. It is further useful as a detergent and astringent of ulcers.¹ To this description Galen adds that it is a deobstruent of the liver and spleen; and in Pliny we find it mentioned as good for strumous tumors when applied in an ointment, with honey for affections of the genital organs, and with vinegar in lichenous eruptions. He dwells particularly on its value in pulmonary complaints.² This latter application of the medicine is strongly insisted upon by Alexander Tralles, Cælius Aurelianus, and the Arabian writers, who also specify that the dyspnoea in which it is most useful is that produced by an accumulation of mucus in the air-passages. They recommend its decoction to be given internally, and cataplasms containing the leaves to be applied to the chest. The latter application is also advised in flatulent colic. The value of the juice in inflammations of the eyes, opacity of the cornea, and ulcers of the eyelids or of the cornea, is hinted at by the Greek, but strongly expressed by the Arabian authorities.³ Its influence on jaundice, connected with enlargement of the liver, has been asserted by many writers, such as Zacutus Lusitanus, Chomel, and Forestus;⁴ and some cases of dropsy, associated with hepatic disease, are also said to have been cured by its use.⁵ These citations are sufficient to show in what esteem horehound was formerly held, and if it has now fallen into disuse, except as a domestic remedy, the reason must be looked for in the number of more powerful remedies which the *Materia Medica* possesses at the present day.

ACTION AND USES.—Horehound may be regarded as a stimulant tonic, and therefore applicable to all cases of gastric atony, besides which it appears to have a special relation to the pulmonary mucous membrane, and by its stimulant operation to reduce and improve the secretions from this part. The popular use of horehound candy seems to show a general confidence in its virtues, which in that form, however, must be altogether insignificant. The expressed juice of the fresh plant taken with milk has been recommended by Dr. Griffith in chronic bronchitis. It was the juice that was particularly esteemed

¹ *Mat. Med.*, lib. iii. cap. cii.

³ EBN BAITHAR, ed. Sontheimer, ii. 251.

⁵ MURRAY, *App. Med.*, ii. 196.

² *Hist. Nat.*, lib. xx. cap. lxxxix.

⁴ ALSTON'S *Mat. Med.*, ii. 172.

by the ancients, and recent testimony is not wanting to show that its virtues are substantial. Horehound has also been used in chronic rheumatism, hepatic and uterine disorders, and as an anthelmintic, to arrest salivation, and in intermittent fever.

ADMINISTRATION.—In *powder* the dose of horehound is from thirty to sixty grains. An *infusion*, made with an ounce of the plant to a pint of hot water, may be taken in wineglassful doses. The *expressed juice* may be given in doses of one or two fluidrachms, three or four times a day, with honey or with milk. A *syrup* is sometimes made which, like the candy already referred to, cannot have very active properties. In Europe an *extract* is prepared which is prescribed in doses of ten or fifteen grains every two or three hours.

CONTRAYERVA.

DESCRIPTION.—Contrayerva is the root of *Dorstenia contrayerva*, a plant which grows in Mexico, Peru, and the West Indies. It is white within, and black exteriorly, nodose, or rough, and furnished with long radicles covered with nodosities like the rootstock. The root of *Dorstenia brasiliensis* (Lam.), according to Guibourt, answers better to the ordinary description of contrayerva; it is of a tawny-brown color, and the rootstock and radicles are, neither of them, nodose. It has a faint and agreeable aromatic odor, and when chewed its taste at first is pleasant, and afterwards pungent and bitter. It contains a volatile oil, bitter extractive, and starch.

HISTORY.—The first account of this medicine was furnished by Monardus, who says that the Spaniards in Peru called it contrayerva because of its virtues as a counterpoison. In 1581, Clusius received from Sir F. Drake some of the roots, and called the plant Drakena, in compliment to the navigator.¹ In 1834, the root was brought to France from Guatemala by M. Bazire, under the name of contrayerva.²

ACTION AND USES.—It is stimulant, diaphoretic, and tonic, and has been used in low fevers, dysenteries, and diarrhœas, as an antidote to the bites of venomous creatures, and as an anthelmintic. It is now seldom or never used.

ADMINISTRATION.—The dose of the powdered root is stated at one or two scruples, and an infusion, prepared with half an ounce of the root in half a pint of boiling water, may be given in doses of one or two fluidounces.

¹ ALSTON, Mat. Med., i. 415.

² GUIBOURT, Hist. des Drogues, 4ème éd., ii. 301.

MILLEFOLIUM.—MILFOIL; YARROW.

DESCRIPTION.—Milfoil is a perennial herb indigenous to Europe but naturalized in this country, where it is largely cultivated by the Shakers. It grows in the fields, on the road sides, and among heaps of rubbish, and blooms in summer and early autumn. "It is about a foot or eighteen inches high, and is distinguished by its doubly pinnate, minutely divided leaves and by its dense corymb of whitish flowers." It has a feeble aromatic odor, which is stronger in the flowers than in the herb, and an aromatic, somewhat bitter and acrid taste. The bitterness is most marked in the leaves. Griffith states that the American is stronger than the European plant. It yields a volatile oil which is most abundant in the flowers, and a bitter extractive which abounds in the leaves, with tannin, &c. Zano announced as its active principles, *achillein* and *achilleic acid*. It imparts its properties both to water and alcohol.

HISTORY.—This plant was employed by the ancients as a medicine, and is said to have derived its specific name from Achilles, whom it cured of a wound. Dioscorides recommended it as a remedy for ulcers and fistula, and for hæmoptysis; Galen as a vulnerary; Arnold of Villanova, Riverius, Trnka, Stahl, and Mellin, in hæmorrhoidal affections; Stahl in portal congestions, Hoffmann for after-pains, and Fuchs in menorrhagia.

ACTION AND USES.—Milfoil is eminently a stimulant tonic, and although not officinal, appears to possess virtues that entitle it to be so. Besides improving the digestion, and, in impressionable persons quickening the circulation, it may, in large doses, produce a sort of intoxication (*vis narcotica*, *inebrians*, *Linn.*). That it exerts an elective influence upon the pelvic viscera can hardly be doubted when it is considered that the most evident of its curative effects are manifested in uterine and hæmorrhoidal affections.

Like all the plants of its class, milfoil can claim to have cured some cases of *intermittent fever*, but in this respect it has but a slender title to our confidence. Nor is it very efficient as a stomachic in cases of *gastric debility*. In *nervous* affections it has always been used with reputed success. In regard to *hæmorrhoids*, the case is different. Besides the authors named above who have found this an efficient remedy, others may be cited nearer to our own time. Hufeland thus describes the particular conditions of its success: "In certain cases the discharge is mucous and not bloody. The patient experiences tenesmus and other hæmorrhoidal symptoms, or has previously had

bleeding piles. . . . The treatment consists in restoring the bloody discharge, or employing the general remedies which hæmorrhoidal disease calls for, or in making use of bitter resolatives and tonics, *especially the infusion of milfoil*, with ferruginous preparations."¹

Teissier has employed it with great advantage in cases of the same description, and when, in the absence of organic disease of the rectum, there was a discharge of mucus and blood, a state which, he well remarks, induces, sooner or later, extreme debility and a cachectic condition.² In a case of this nature, with numerous hæmorrhoidal tumors, discharges of blood, mucus, and albuminous coagula, with prolapsus of the rectum, the writer employed it, to the manifest advantage of the patient, although complete relief was obtained only by a surgical operation.

The influence of the medicine as a remedy for *menstrual* derangements is still more marked. Like many reputed emmenagogues, it appears to be useful in restoring the catamenia to a normal state, both when they are suppressed or scanty and when they are profuse. M. Ronzier-Joly quotes the following passage from an essay by Valmont de Bomare: "Milfoil is employed internally and externally to arrest all sorts of hemorrhages; . . . but women and maidens affected with bleeding piles ought not to continue its use too long, lest it produce a suppression of the catamenia." Dr. B. H. Coates used the infusion of this plant with material advantage in two cases of hemorrhage from the kidneys, three (in the same patient) from the uterus, and one from the lungs.³ Several other writers have reported similar results. But Voigtel says that it is not less indicated in the opposite condition, when the irregularity or suppression of the menses depends upon debility;⁴ and M. Ronzier-Joly has very recently published several cases which go to prove that the medicine is sometimes very efficient in re-establishing the suppressed menses, if it is duly administered at the catamenial period.⁵ He also states that in two cases he employed it successfully in restoring the lochial discharge, as Manoury had also done in the last century.⁶ M. Richart, of Soissons, who, like some of the physicians mentioned above, found milfoil useful in relieving uterine colic in young girls at the establishment of puberty, also employed this remedy as a stimulant in epidemics of *measles* and of *scarlatina* in which the eruption was backward or imperfect. He prescribed the

¹ Med. Prat., par JOURDAN, p. 383.

² Bull. de Thérap., lii. 170.

³ Trans. Philad. Coll. of Phys., Dec. 1854, p. 334.

⁴ System der Arzneim., iii. 426.

⁵ Bull. de Thérap., lii. 260, 313, 550.

⁶ Anc. Journ. de Méd., xxxiv. 402 (1770).

infusion as a drink and as an injection, and also had the patient placed in warm baths impregnated with this herb. It might be supposed that the apparent efficacy of the treatment was due to the warm water of the baths rather than to their medicinal ingredient; but they, as well as other means, were tried previously, and failed. The same method was used successfully in cases of convulsions occurring during dentition.¹

Many cases of *leucorrhœa* and of *flatulent colic* are reported to have been cured by this remedy.

The infusion has also been recommended as a gargle in relaxation of the *uvula* and *pharynx*, and as a wash for *sore nipples* and other ulcerated surfaces.

ADMINISTRATION.—An *infusion*, made with half an ounce of the tops of the plant to half a pint of water, and reduced by heat to six ounces, may be given by tablespoonfuls every hour. The *expressed* juice is prescribed in doses of one or two fluidounces three times a day.

CALAMUS.—SWEET FLAG.

DESCRIPTION.—Calamus is the rhizome of *Acorus calamus*, a native perennial plant of the United States, of Europe, Egypt, and India, where it grows in damp and marshy situations. The leaves are radical, long, flat, and ensiform, and of a reddish color below. The flower (spadix) is bobbin-shaped, about two inches long, and terminating in a tuft of greenish-yellow florets. The root, or rhizome, which is sometimes several feet in length and half an inch or more in thickness, and jointed, runs horizontally near the surface of the ground. It gives off numerous radicles. When dried and prepared for sale these are removed, and the rhizome itself is much shrunk. It is of a light and spongy texture, of yellowish-brown externally, and of a white or pinkish-white color within.

The odor of calamus is very agreeable, and it has a warm, aromatic, pungent, and somewhat bitterish taste. These qualities of the root appear to depend upon a volatile oil, a resinous principle, and extractive matter, and they are much impaired by keeping. It yields its virtues to boiling water.

ACTION AND USES.—Calamus excites a sense of warmth in the stomach, promotes the appetite, and improves the digestion. It is said also to quicken the pulse and increase the secretions of the skin and

¹ Abeille Méd., Mai, 1850.

kidneys. In large doses it is reported to stimulate the circulation unduly and occasion headache.

It is used as an ingredient of infusions of bitter tonics in those cases of dyspepsia, or torpor of the stomach, especially with flatulence, which call for stimulants, and in those numerous chronic affections in which this state of the digestive organs depends upon general atony of the system. Ainslie informs us that it is a very favorite medicine of the East Indian practitioners, and is reckoned so valuable in the indigestions, stomach-aches, and bowel affections of children, that there is a penalty incurred by any druggist who will not open his door in the middle of the night and sell it if demanded.¹ On the Malabar coast a bath made of an infusion of the root is considered an efficacious remedy for epilepsy in children. The Arabians and Persians place it among their aphrodisiacs and carminatives. The Turks candy the roots, and regard them as a preventive against contagion. Like other stimulant tonics, it has been used successfully in mild cases of intermittent fever, and is not to be neglected as an adjuvant to bark and quinia. As a stimulant it may be used with profit in typhus fever, and in the typhoid state of various febrile affections. It has also been thought to have peculiar virtues in chronic gout.

ADMINISTRATION.—*Powdered* calamus may be given in doses of from twenty to forty grains or more. The root also may be chewed habitually as a remedy for the dyspeptic symptoms mentioned above. An *infusion* made by digesting an ounce of calamus in a pint of water may be prescribed in the dose of two or more fluidounces.

AURANTII CORTEX.—ORANGE PEEL.

DESCRIPTION.—Orange-peel is the dried rind of the fruit of *Citrus vulgaris* and *C. aurantium*. The former is the bitter and the latter the sweet orange. In commerce orange-peel is found in elliptical concavo-convex pieces, or in thin parings, and retaining more or less of the pithy white substance which unites the rind to the pulp. The bitter variety is most active as a medicine, as it contains a bitter principle, and also in common with the other variety, an essential oil which abounds in the follicles of the rind. Orange-peel yields its virtues to alcohol and water.

HISTORY.—The orange tree is a native of Eastern Asia, but was introduced into the Levantine countries early in the Christian era, and

¹ Mat. Indica, i. 417.

into Spain by Juan de Castro in 1520. It was thence transported to the West Indies and the adjacent portions of the American continent. Orange-peel was employed as a remedy by the Arabian physicians, by whom it was reputed to be stimulating, an excellent remedy for colic, and also for intestinal worms.¹

ACTION AND USES.—Orange-peel has an aromatic smell and a warm, pungent, and bitter taste. It stimulates the digestive organs and produces in the stomach a grateful sense of warmth like other substances of the aromatic class. The oil would appear to be endowed with very active properties. At Clermont Ferrand, in the South of France, the China orange is very largely cultivated for the sake of its rind. The persons employed in removing it are singularly affected. Their hands become inflamed with an erythematous, a papular, or a vesicular eruption; they suffer from headache, dizziness, tinnitus aurium, deafness, neuralgia, oppression in breathing, constriction of the throat, nausea, pyrosis, eructations, and thirst. They are disturbed by dreams, experience twitching and cramps of the muscles, and sometimes epileptiform convulsions. All of these symptoms disappear when the occupation that caused them is abandoned.² M. Imbert-Gourbeyre, who furnishes this account, states that he has employed the essential oil with success as a remedy for hysterical and other nervous affections.

Orange-peel is employed in medicine chiefly to qualify the operation of pure bitters, and thereby to obtain a speedier and more decided impression, or to render those medicines more acceptable to the stomach. Like the aromatics, it is sometimes associated with purgative medicines that are apt to gripe, or when the bowels are distended with flatus. The peel of the sweet is preferable to that of the bitter orange for the latter purpose.

ADMINISTRATION.—Orange-peel is generally prescribed as an addition to infusions and decoctions. In the latter case the bruised peel should be added after ebullition has terminated, and in the proportion of three or four drachms to a pint of the liquid. A *syrup* made with a vinous tincture of orange-peel forms an agreeable addition to bitter infusions and other stomachic preparations of that nature. A compound *tincture* of orange-peel (*Elixir aurantiorum compositum*, Ph. Bor.) prepared by digesting in Madeira wine, cinnamon, carbonate of potassa, and extracts of gentian, absinth, water trefle, and cascarilla, is much used in Germany as a stomachic.

¹ EBN BAITHAR, ed. Sontheimer, ii. 545.

² CANSTATT'S Jahresbericht für 1853, p. 158, from Gaz. Méd. de Paris.

ANGELICA.—GARDEN ANGELICA.

DESCRIPTION.—Angelica is the root of *Angelica Archangelica*, a native plant of Lapland, Norway, and the mountainous regions of Central Europe. It is also cultivated as a garden plant in many parts of that country, and, occasionally, in the United States. The stem, which is four or five feet high, is hollow, fluted, of a bright green color, and very fragrant, as are also its large doubly pinnated leaves, and its flowers arranged in large umbels of a greenish white color. The root is large, fleshy, very aromatic, and in the spring season furnishes, on incision, a musky juice.

Candied angelica stalks are still sold by confectioners and are a favorite preserve, but the root only is employed by druggists. It consists of a cylindrical head with numerous long and stout radicles. Externally its color is grayish brown, but it is white within. It has a strong and peculiar but not disagreeable odor, and a bitter and persistently acrid taste. Its properties are extracted by alcohol and less perfectly by water. They depend chiefly upon an essential oil, a peculiar acid, bitter extractive, and various minor constituents.

HISTORY.--In the middle ages this medicine was very highly prized, and its very name indicates a belief in its celestial virtues. In the North of Europe, where it most abounds, it was peculiarly esteemed. The Laplanders are said to be very fond of its green shoots as a salad, and they preserve the mature stalks as a seasoning for food, and as a remedy in pulmonary complaints. They also use a decoction of the buds in whey as a diaphoretic, stomachic, &c. The Norwegians employ the root for similar purposes.¹ In the English edition of Pomet² it is stated that the seed is used to make angelica comfits, and the stalk a very good sweetmeat candied. "It is cordial, bezoartick and alexipharmick, heats, dries, opens and attenuates, and causes sweat, resists poison, and cures the bitings of venomous creatures . . . besides which, it provokes the terms, expels the birth, resists poison, helps suffocation of the womb, cures palsies, apoplexies, convulsions, cramps, and rheumatisms." To this Lemery adds that it is used in the plague and malignant fevers and for the biting of mad dogs.

ACTION AND USES.—Angelica possesses the properties of a stimulant tonic, but is more stimulant than tonic. It has been compared to *sencga* and also to *serpentaria*, like both of which it may, in large

¹ MURRAY, App. Med., ed. alt., i. 373.

² A Compleat History of Drugs, 3d ed. 1737, p. 39.

doses, act as a diaphoretic or an emetic. But it appears to have a closer resemblance to ealamus.

As a medicine, angelica has been used chiefly to combat the symptoms of the *typhoid state*; and in the convalescence from acute diseases. Hildenbrand preferred it (as being an indigenous remedy) to serpentaria in typhus, and states that he had used it with the greatest success in hundreds of cases of this disease.¹ But it is probably in the less decidedly adynamic states which attend the convalescence of febrile affections, and when some agreeable and stimulant tonic is required to revive the vigor of the stomach, that angelica is most directly indicated. Yet, apart from its more grateful taste, which must be admitted to present advantages, it is not easy to perceive its superiority over chamomile and other similar remedies. The vogue which angelica enjoys as a domestic remedy for *catarrhal* affections, and particularly those of aged and feeble persons, makes it probable that it is really of value in these diseases, under the same circumstances indeed in which senega is usually prescribed. As the latter medicine is nauseous, the substitution of angelica for it, in the cases referred to, might be advantageous.

In *rheumatism*, *gout*, *intermittent fever*, &c., angelica is said to have been sometimes beneficial.

ADMINISTRATION.—Angelica root may be given in *powder*, in doses of from ten to thirty grains every two or three hours. An *infusion* made with white wine or water, in the proportion of a pint to an ounce of the root, may be given in doses of a tablespoonful every two or three hours.

ANGELICA ATROPURPUREA.—This is an indigenous species of angelica, somewhat resembling the European. Its name is derived from the purplish color of its stem. It is officinal in the secondary list of the U. S. Pharmacopœia. When recent, the root is aërid, and is said to be poisonous; but when dried it is used as a carminative and stimulant. Like the foreign plant, the stems of this species are sometimes candied. Still another indigenous species, *A. lueida*, is said to possess aromatic qualities similar to those above described.

WINTERA.—WINTER'S BARK.

DESCRIPTION.—Winter's bark is in quills of different dimensions, externally of a pale yellow or reddish-gray color with dark spots, and

¹ Du Typhus Contagieux, p. 213.

internally of a reddish-brown color. It has an aromatic smell, and a hot, spicy, and pungent taste. It contains resin, volatile oil, tannin, &c.

HISTORY.—This is the bark of *Drimys Winteri*, a forest tree of the southern parts of South America, which was named in honor of Captain John Winter, who commanded the vessel in which Drake intended to sail around the globe in 1577. Owing to tempestuous weather in the Straits of Magellan, Winter abandoned the expedition, and returned to England in 1579, bringing with him a supply of this bark.¹ He used it as a condiment during the voyage, and attributed to it the cure of scurvy, which broke out among his crew.

ACTION AND USES.—This bark is said to be stimulant, aromatic, and tonic, but the evidence of its possessing the last-named quality is slight indeed. It is seldom used, and very little of it is to be found in commerce. The dose of the powder is half a drachm.

The following stimulant tonics have been treated of in other divisions of this work:—

HUMULUS,	vid. <i>Narcotics</i> .
SERPENTARIA,	" <i>Diaphoretics</i> .
MYRRHA,	" <i>Antispasmodics</i> .
ABSINTHIUM,	" <i>Anthelmintics</i> .
TANACETUM,	" "

TONIC AND AROMATIC STIMULANTS.

A NUMBER of the medicines belonging to this class are in common use under the general title of aromatics, or spices. All are vegetable products, and are furnished by the natural families Labiatae, Synantherae, Umbelliferae, Laurineae, &c. They contain volatile oils, and several of them a bitter or acrid principle in addition. The former are often separated by distillation, to be employed in a pure state, and, diluted with alcohol, they constitute the *Spirits* of the Pharmacopœia.

The properties which these medicines possess in common are those of local and general stimulants, with a greater or less, but always subordinate, degree of tonic power. Two of them only, sage and rue, approach by their bitterness to the articles of the preceding class.

¹ Med. Obs. and Inq., v. 41.

Applied externally, they act as rubefacients, as in the familiar example of the spice-plaster. As internal stimulants their action is first denoted by their sharp, biting, and warm taste, the irritation they produce in the fauces, and the sense of warmth which they excite in the stomach, a sensation which often seems to diffuse itself throughout the whole abdomen, while the action of the heart is quickened in a sensible degree. Perhaps this effect is produced through the medium of the sympathetic nerve, for there is nothing to indicate that the brain or spinal marrow participates directly in the excitation when these articles are administered in medicinal doses. Their influence is restricted to the alimentary canal, or, in the case of certain of them, to several other abdominal organs. Thus rue and milfoil are believed to be emmenagogue, cinnamon is said to be an excitant of the gravid uterus, and cubebs and parsley are regarded as diuretic. Many, especially of the Labiatae, act as stimulant sudorifics when given in warm infusion, while sage, as an astringent, tends to diminish excessive perspiration from debility.

We have said that, in ordinary doses, medicines of this class, in their natural state, do not affect the brain, but when their essential oils are administered in large quantities the effects are marked, and may even, in some instances, be fatal. A sort of intoxication, resembling that of alcohol, is usually produced, accompanied or followed by general prostration, coldness, and insensibility. But the different agents produce somewhat different effects, and those of nutmeg are peculiar in being decidedly narcotic.

The most common application of aromatic medicines is their use as corrigents of food which might disagree with a weak stomach, or of medicines which tend to occasion nausea. For the former purpose they are much more generally employed by the cook than by the physician. They enter into the composition of many of the cakes and confections dear to youthful palates, and thus palliate the evils of overloading the stomach with such mischievous productions. In this country ginger and cinnamon are the ordinary condiments of these preparations, but in Germany anise, cumin, and caraway are the favorites.

Associated with other medicines, aromatics are very useful to disguise the taste of those which are offensive to the palate, and the odor of such as have a repulsive smell; they also, by their own agreeable odor and flavor, render even tasteless and scentless preparations attractive to the fastidious or the whimsical. Very often the stomach will not retain certain substances, which irritate it mechanically or otherwise excite nausea, unless it is stimulated, and perhaps its sensibility at the

same time obtunded, by preparations of the aromatic class. It is probably the latter influence which renders these medicines so useful as corrigents in purgative compounds. Nearly all cathartics may occasion more or less pain during their operation, and opiates are often associated with them to palliate this inconvenience; but, as they likewise counteract the purgative action, they are less eligible than aromatics, which stimulate rather than diminish the peristaltic movements of the intestine. They are, however, contraindicated when an inflammatory condition of this organ exists.

Aromatic stimulants are in ordinary use as carminatives, or medicines which expel flatus.¹ A singular notion has prevailed that the pain of flatulent colic is owing to spasm of the intestine, and that carminatives relieve the one by relaxing the other. But the least consideration demonstrates that pain from flatus, whether in the stomach or in the colon, is produced by an over-distension of these parts, for no sooner does the gas escape than the pain is relieved. Debility of the intestine is the condition in which flatulent colic is most apt to occur. Stimulants become carminatives because they excite the gastro-intestinal canal to contraction, and thus provoke the expulsion of the distending cause. In addition to this, they probably exert an anodyne or soothing influence on the nerves of the alimentary canal, and render it less susceptible to the irritation of its contents. As a general rule, the concentrated forms of these medicines, and in particular their essential oils, are the most appropriate for exhibition in flatulent colic. When sickness of the stomach exists, they may be mixed with olive oil and employed as an embrocation for the abdomen; or the fresh herb of the plant, when it can be procured, may be bruised and applied as a cataplasm to the same part. It should be remembered that carminative medicines do not, in general, remove the cause of the flatus which they expel. This, which may arise from the decomposition of food, or from a secretion into the bowels induced by defective innervation, requires for its cure evacuants in the one case, and in the other tonics and astringents.

Their action upon the nervous system explains the common use of these medicines in various affections characterized by irregular and spasmodic action of the muscles, such as hysterical dysphagia, hiccup, spasm of the gall-ducts and ureters, and some forms of dysuria and dysmenorrhœa. But in all of these disorders, except the first two,

¹ "Carminare signifies to assuage with verses (*carminibus*): for the ancients thought that poets, by means of their verses, could assuage pains and too vehement motions."
—BOERHAAVE, *Powers of Medicines*, p. 303.

narcotics are more efficient remedies. Several of the class (cinnamon, rue, pennyroyal, rosemary) are thought to possess a specific power of exciting contraction in the gravid uterus, or, in general terms, of stimulating this organ. Another, black pepper, is supposed to possess peculiar anti-periodic qualities.

Many stimulants contain an acrid principle which acts as an irritant when they are applied to the skin. This is strikingly the case with horsemint, ginger, black pepper, cajeput, and some others. Hence these substances, or the essential principles derived from them, are often used when local stimulant, counter-irritant, and anodyne impressions are desired in combination. Such conditions are presented in cases of flatulent colic, already noticed, in neuralgia, and in sub-acute and chronic rheumatism, particularly of the form which affects the muscles exclusively.

ANISUM.—ANISE.

DESCRIPTION.—Anise is the fruit of *Pimpinella anisum*, a small annual plant native of Egypt, Syria, and Greece, but cultivated in many parts of Europe, and occasionally in this country. The seeds, or fruit, are oval, about a line in length, striated, downy, and of a yellowish-brown color. They have a fragrant odor, and a sweet, warm, and aromatic taste. These properties are due to a volatile oil which is contained in the envelope of the seeds, and is separated by distillation. They impart their qualities to water, but more perfectly to alcohol. Oil of anise is whitish or yellowish, and has in an intense degree the smell and taste of the seeds. It is much employed in the manufacture of a cordial known as *anisettes*.

HISTORY.—Anise was well known to the ancients. Dioscorides says it sweetens the breath, is diuretic and resolvent, and assuages the thirst of the dropsical. It resists the poisons of venomous creatures, is carminative and binding; restrains leucorrhœa, excites the secretion of milk, and is aphrodisiac.¹

ACTION.—Strumpf found that the oil of anise destroyed rabbits in a less dose than six drachms. Somewhat less than three drachms given to a young cat occasioned palpitation of the heart and exhaustion, and constipation which continued for two days. The urine was discharged as usual, and the animal evinced much thirst. A single drop of the oil placed upon the skin of a canary bird under the wing,

¹ Lib. iii. cap. lvi.

excited signs of pain followed by lethargy and insensibility, and death in four hours. The body resisted putrefaction for six weeks. Two or three drops rubbed on a sparrow's head rendered it dull for several hours.¹

USES.—Anise is used to expel flatus and relieve the pain caused by its distension of the stomach. It is said, also, to promote expectoration in chronic catarrhs. It is often used to mitigate the griping of purgatives, such as senna, rhubarb, and jalap.

ADMINISTRATION.—From ten to twenty grains of bruised anise may be given at a dose. Or an infusion made with two or three drachms of the bruised seeds to half a pint of water, may be directed in tablespoonful doses. Oil of anise (OLEUM ANISI) is given in the dose of from two to six drops on sugar, or in sweetened water.

ASARUM.—CANADA SNAKEROOT.

DESCRIPTION.—This is the root of *Asarum Canadense*, a small perennial plant, indigenous to the United States and Canada, and growing in shaded woods, especially in hilly situations. As found in the shops, the root (rhizome) is in small contorted pieces about as thick as a quill, frequently furnished with short fibres, wrinkled and brownish externally, but whitish within, and of a hard brittle texture. It has a spicy, bitter taste, which is thought to resemble that of cardamoms, and, when fresh, it also has an agreeable aromatic smell. The powder of the dried leaves is a powerful errhine. This root yields its properties to water, but more completely to alcohol. They appear to depend upon an essential oil, and an acrid and bitter resin.

USES.—Canada snakeroot is an aromatic stimulant, with some tonic qualities. Its warm infusion, like that of other medicines of the same class, is diaphoretic. It is popularly employed to relieve flatulent colic, and has been used medicinally as a substitute for serpentaria in diseases of a typhoid type.

ADMINISTRATION.—The powdered root may be given in doses of twenty or thirty grains; or the infusion, made with half an ounce of the root and a pint of boiling water, may be prescribed in doses of a wineglassful. Dr. Wood has suggested the preparation of a tincture by macerating four ounces of the root in two pints of diluted alcohol, to be used as an addition to tonic infusions.

¹ Handbuch, i. 611.

OLEUM CAJUPUTI.—CAJEPUT OIL.

DESCRIPTION.—This medicine is the volatile oil of *Melaleuca cajuputi*, a small tree of the Molucca Islands, belonging to the natural family of Myrtaceæ. Its name, in the language of the natives, signifies *white tree*, and serves to indicate the white bark for which it is remarkable. The oil is obtained from its leaves by distillation in copper vessels, and, according to Guibourt, it always contains a trace of this metal, which communicates to it the greenish tinge for which it is peculiar. But this statement has not been confirmed. It is very fluid and transparent, has a hot, aromatic taste, followed by a sense of coolness in the mouth, and a strong but agreeable odor, which is stated to resemble that of turpentine, camphor, peppermint, and rose, together. It is wholly soluble in alcohol.

HISTORY.—Cajeput oil was first brought into notice in 1717, by Locher. According to Rumphius, it is employed in Amboina, and the neighboring countries, as a stimulant diaphoretic.

ACTION AND USES.—When swallowed, cajeput oil excites a sense of warmth in the stomach, quickens the pulse, and increases the perspiration and the urine. The Malays are in the habit of prescribing it internally in epilepsy and palsy, and, according to Ainslie,¹ it is a highly diffusible stimulant, antispasmodic, and diaphoretic, and may be efficaciously given in dropsy, chronic rheumatism, palsy, hysteria, and flatulent colic.

Cajeput oil is used internally as a remedy for flatulent colic, particularly when it is produced by cold or by the retrocession of inflammations, gouty or otherwise, of the skin or extremities, and when the menses are suspended or diminished, and attended with pain, under the influence of similar causes. In some spasmodic affections of hysterical persons, and particularly in cases of nervous vomiting, nervous dysphagia, dyspnoea, and hiccup, it is of marked utility. It has also been used as a vermifuge.

As a local rubefacient stimulant it is employed diluted with olive oil, in cases of functional paralysis. With almond oil it is applied on cotton to the auditory canal for the relief of deafness. It forms one of the best remedies for toothache depending upon caries, when a drop of it on cotton is introduced into the hollow tooth; and a few drops rubbed upon the painful part form a remedy for nervous headache that is often effectual.

¹ Mat. Ind., i. 261.

ADMINISTRATION.—Internally, cajeput oil may be given in doses of from two to ten drops, on sugar, or with Hoffmann's anodyne, or with the tinctures and infusions of other antispasmodic medicines.

CINNAMOMUM.—CINNAMON.

DESCRIPTION.—Cinnamon is the inner bark of *Cinnamomum Zeylanicum*, a native tree of Ceylon, whence it has been introduced into the Malabar country, and into Cayenne and Brazil. The tree is about thirty feet high, and its smaller branches afford the bark of commerce. It is in the form of quills of various sizes, the smaller being introduced into the larger, and from two to three feet or even more in length. The bark is smooth, about the thickness of wrapping paper, of a dull yellowish brown color, has a splintery fracture, and is easily reduced to powder. It has a warm, sweetish, aromatic, and somewhat astringent taste, and a very agreeable and delicate odor, qualities which it owes to an essential oil. Besides the oil, of which it yields six parts in a thousand, cinnamon contains tannin, resin, cinnamic acid, &c.

HISTORY.—Cinnamon appears to have been known to the ancient nations inhabiting the countries bordering upon the Levant. It is the *κινναμωμον* of Herodotus, a name which he states the Greeks learned from the Phœnicians. The name seems to be derived from the Cingalese *Cacinnama* (dulce lignum), or the Malay *Kaimanis* (Royle). It is spoken of in the Hebrew Scriptures;¹ in the Hippocratic writings it is mentioned as a remedy for after-pains; Pliny refers to it as a costly aromatic used in burning the dead,² and states that it is brought from Central Africa. Dioscorides describes five or more varieties of cinnamon, and says that it is diuretic, emmenagogue, and ecbotic, and acts as an antidote to poisons and to the bites of venomous animals. He adds that with honey it removes freckles from the face, that it is useful in catarrhs, dropsies, diseases of the kidneys, and dysuria.³ Galen and Paulus Ægineta remark that it is highly desiccative. The Arabian writers attribute to cinnamon the virtues that have been mentioned, and others besides. Sofia, of Andalusia, asserts that it renders the voice clear when it has become hoarse from mucus in the air-passages, and that it diminishes secretion from these parts and from the posterior fauces, and indeed from all of the organs. It is even serviceable, he declares, in anasarca and ascites. Rhazes says that it promotes digestion, and relieves pain in atony of the stomach, and recom-

¹ Exodus xxx. 23.

² Hist. Nat., xii. 41.

³ Mat. Med., i. xiii.

mends that for these affections it should be mixed with the food. He adds that it has a tendency to occasion flatulence and excite erections. Avicenna refers to its astringent qualities, and Galen, like Dioscorides and other ancient writers, distinguishing between cinnamon and cassia, says that the latter may be employed when the former cannot be procured but in double the dose.¹

ACTION. *On Animals.*—Mitscherlich showed in his experiments upon rabbits, that these animals are killed in five hours by a dose of six drachms of the essential oil of cinnamon. The symptoms produced by it were violent action of the heart, hurried respiration, anxiety, evacuation of solid fæces, debility, insensibility, slow and labored respiration, coldness of the extremities, and death. The gastro-intestinal mucous membrane was not inflamed, but in many places was abraded, and here and there points of effused blood existed in the glandular layer of the membrane. The odor of cinnamon having been very perceptible in the breath of the animals during the experiments, and in the urine as well as in the peritoneal cavity after death, it is probable that the effects depended upon the absorption of the oil and its influence on the nervous system rather than upon its local action upon the digestive organs.

On Man.—When oil of cinnamon is rubbed upon the skin it occasions slight redness and a pungent heat; but these effects are transient. When swallowed, the oil; and also the powder of cinnamon in a less degree, excites a sense of warmth in the stomach, and a temporary increase of the appetite and digestive power. If its administration is continued, constipation of the bowels ensues. In all inflammatory states of the gastro-intestinal mucous membrane it is to be avoided.

USES.—Cinnamon water and oil of cinnamon are much employed to give an agreeable flavor to medicinal compounds and to render them acceptable to the stomach. The slight astringency of the former renders it peculiarly appropriate as a vehicle for more actively astringent medicines, while its stimulant properties tend to expel the flatus and to alleviate the pain which are the usual attendants of diarrhœa produced by cold or by irritating ingesta. If the bowels contain none of these, or if they have been removed by a laxative, the chalk mixture (*Mistura Cretæ*) of which cinnamon water is the excipient, and to which the tincture of catechu, or laudanum, or both, may be added according to the predominance of diarrhœa or of colic, is one of the most common and useful of prescriptions.

In Germany cinnamon has long been regarded as peculiarly adapted

¹ EBN BAITHAR, ed. Sonthheimer, i. 404.

to control uterine hemorrhages and to promote contraction of the distended uterus. Van Swieten asserts that he found the tincture useful in the former; and Plenck says that he had very frequently used it in these affections, during as well as after labor and in the non-gravid state, and that he believed it to be as really a specific for uterine hemorrhage as cinchona is for ague.¹ Mursinna, also, while he disapproves of its use during pregnancy, attributes to it the greatest efficacy during labor and when hemorrhage depends upon atony of the uterus.² Richter, speaking of the general esteem in which the medicine is held, says that no sooner does uterine hemorrhage become excessive and produce exhaustion, or even threaten life, whether it be from profuse menstruation or during pregnancy or labor or after delivery, it is customary to have recourse to cinnamon. He, however, would restrict its use to atonic hemorrhages in the non-gravid state, and to those depending upon a flacid state of the uterus after delivery, and he affirms that it is especially serviceable on account of its property of promoting contractions of the uterus.³ Sundelin furnishes precisely the same account,⁴ and Vogt does not suggest a doubt of its accuracy,⁵ but more recent writers, as Clarus and Esterlen, appear to be sceptical upon the subject. Yet one of the latest, Werber, presents as favorable an opinion as any before him of its efficacy in arresting uterine hemorrhage and promoting uterine contraction.⁶ In England, although less known, tincture of cinnamon was recommended by Dr. Gooch as one of the ingredients of a mixture in menorrhagia; Dr. Rigby places cinnamon in the same group with ergot and borax; and more recently Dr. Tanner has found it useful in moderating the menstrual discharge in cases which did not appear to depend either upon plethora, anæmia, or uterine organic disease. He also found that it seemed to increase the severity and rapidity of the pains of labor, and to diminish the loss of blood.⁷ More recently still M. Teissier has furnished an equally favorable account of the hæmostatic virtues of this medicine.⁸ After referring to its successful employment by Schmidtman, Frank, and Gendrin, he states that in menorrhagia depending upon chlorosis or anæmia it is superior to all other hæmostatics when administered during a few days preceding the menstrual period; that in hemorrhage preceding, accompanying, or following labor in women of lax tissue and feeble circulation, and who are subject to irregular menstruation and chronic leucorrhœa, he has

¹ MURRAY, App. Med., iv. 438.

³ Ausfür. Arzneim., iii. 120.

⁶ Pharmakodynamik, ii. 635.

⁷ Lancet, Oct. 1853, p. 363.

² Ibid., p. 440.

⁴ Heilmittellehre, ii. 200.

⁶ Heilmittellehre (1856), i. 308.

⁸ Bull. de Thérap., xlix. 76.

found it of evident advantage; and finally that it is one of the best means of moderating the exhausting hemorrhages caused by cancer of the womb.

These various testimonials appear to leave no doubt in regard to the reality of the virtues claimed for cinnamon; and while it would be irrational to give it the precedence of ergot and of ergotine in the several conditions alluded to, it possesses advantages as a stimulant which render it more peculiarly appropriate in those cases for which iron is the more certain but less prompt constitutional remedy.

ADMINISTRATION.—*Powdered* cinnamon may be prescribed in doses of from ten to thirty grains. The *tincture* (TINCTURA CINNAMOMI), and the *compound tincture* (TINCTURA CINNAMOMI COMPOSITA), are given in doses of from one to four fluidrachms. The *oil* may be directed in doses of from one to three drops, diffused by means of finely pulverized sugar in water; or the officinal *cinnamon water* (AQUA CINNAMOMI) may be substituted for it in the dose of from half a fluidounce to a fluidounce. An extemporaneous *infusion* of cinnamon is often made with two drachms of the bruised bark to a pint of boiling water, and given in doses of two or more tablespoonfuls. It also forms an important ingredient of the *aromatic powder* (PULVIS AROMATICUS), in which it is associated with ginger, cardamom, and nutmeg. This preparation is given in doses of from ten to thirty grains. When inclosed in a flannel bag, and moistened with hot brandy, or, after the addition of hot spirit, rendered tenacious by means of molasses or honey, cinnamon forms one of the most soothing applications that can be made to the abdomen in cases of flatulent colic or cholera morbus. The *aromatic confection* (CONFECTIO AROMATICA), which also contains cinnamon, is sometimes prescribed for the relief of flatulent colic and of simple diarrhoea.

CASSIA.

DESCRIPTION.—Cassia is the bark of *Cinnamomum aromaticum* or *C. cassia*, a native tree of China, but cultivated in Java. It is imported in bundles shorter than those of cinnamon, and formed of thicker pieces of bark, which also are not inserted one within another. Its color is of a darker brown than that of cinnamon, and its texture is coarser. Its odor is less delicate, and its taste, which is also less agreeable, has a certain harshness and bitterness. It appears to be more astringent than true cinnamon, but, according to published analyses, its constituents are essentially the same. Its physical pro-

perties and its effects, however, show it to be less rich in active principles than the latter.

In the United States Pharmacopœia this bark and that of Ceylon cinnamon are comprised under the name of the latter; but all usage, from the time of Dioscorides to the present day, is in favor of their separation. The remark of this writer and of Galen respecting their unequal value has already been given, viz., that cassia has only half the strength of cinnamon. It seems to be desirable, therefore, that Ceylon cinnamon should, as far as possible, alone be used for medicinal purposes.

CANELLA.

DESCRIPTION.—The inner bark of *Canella alba*, a tall tree which is a native of Jamaica and other West India islands. It occurs in quills from a few inches to two feet in length, which are derived from the smaller branches, and are often twisted; they are of a pale or grayish orange color externally, but whitish on the inner surface, brittle, with a granular fracture, and have an agreeable aromatic smell like that of cloves and nutmegs, and an acrid, bitterish, and pungent taste. The pieces of canella are sometimes taken from the bark of the trunk or larger branches, in which case they are coarser, thicker, and darker on the exterior, and not so much quilled as the other variety.

Canella contains a volatile oil, resin, and bitter extractive, the last of which it yields to water, but the others more perfectly to alcohol.

ACTION AND USES.—As might be expected from its composition, canella is both tonic and stimulant, and may be employed whenever there is gastric debility without organic cause. It is seldom used alone, but is frequently associated with other tonics, and also with some purgative medicines whose operation is debilitating, or which have a local action which it is designed to augment. Of the former description are jalap and scammony, and of the latter aloes.

ADMINISTRATION.—The dose of canella, in *powder*, is from ten to forty grains. Its association with aloes is officinal (PULVIS ALOES ET CANELLÆ), and has been extensively used as an emmenagogue in doses of from ten to twenty grains. Canella is an ingredient of the *wine of rhubarb* (VINUM RHEI), a cordial laxative in doses of from one to four fluidrachms; and also of the *wine of gentian* (*Ed.*), a stomachic tonic, which is given in doses of from half an ounce to an ounce.

CARYOPHYLLUS.—CLOVES.

DESCRIPTION.—Cloves are the undeveloped flowers of *Caryophyllus aromaticus*, a native tree of the Molucca Islands, but also now extensively cultivated in Sumatra, the Mauritius, Bourbon, the West India Islands, and South America. The flowers are composed of a tubular calyx, divided superiorly into four lobes, and supporting a corolla of four petals, which in their unexpanded state have a globular form. These flower-buds, which have the appearance of a small nail (*clou*, Fr.), are about half an inch long, of a dark brown color externally, but reddish within; they have a strong and fragrant smell, and a hot, aromatic, somewhat bitter and persistent taste.

Cloves contain eighteen per cent. of a volatile oil, besides tannin, gum, and resin, and a crystallizable principle probably derived from the oil. Their active properties are completely extracted by alcohol, but imperfectly by water. The oil is white, yellowish, or brownish, and has a penetrating smell and a fiery aromatic taste.

HISTORY.—Cloves were unknown to the ancient Greek and Latin medical writers, and the first who mentions them is Paulus Ægineta, (A. D. 634), who speaks of them chiefly as condiments. The Arabians were well acquainted with their source and characters. They regarded them as emmenagogue, and aphrodisiac, and as fitted to promote conception; as carminative, also, and adapted to allay vomiting; as a suitable condiment to prevent flatulence arising from vegetable food; as useful to strengthen spongy gums and to sweeten the breath, to promote digestion, to expel tænia, to cure atonic diarrhœa, and anasarca, and to relieve coryza when bruised and applied to the forehead.¹

ACTION AND USES.—Moderately used, cloves, like other aromatics, stimulate the digestive function, but gradually exhaust the susceptibility of the stomach, and occasion loss of appetite and constipation. The oil acts as a diffusible stimulant when taken in a somewhat diluted state, but in large doses and undiluted is a powerful irritant.

Cloves are rather a condiment than a medicine for internal use, and hence are commonly employed to season food containing much fat, or which is otherwise indigestible. An infusion of cloves may be given to allay nausea, or to relieve the pains of flatulent colic. They are sometimes chewed in cases of paralysis of the tongue or cheek as a local excitant; they are an ingredient of the spice plaster (*Pulvis aromaticus*), which is an excellent anodyne in flatulent and nervous colic;

¹ EBN BAITHAR, ed. Sontheimer, ii. 281.

they enter into several formulæ for dentifrice; the oil is frequently applied on cotton to carious cavities in teeth with a view of allaying pain, and sometimes to the interior of the auditory canal in cases of deafness from nervous debility.

CARDAMOMUM.—CARDAMOM.

DESCRIPTION.—The officinal cardamom is the fruit of *Elettaria cardamomum*, which grows abundantly on the Malabar coast of Hindostan. It is a perennial plant, from six to nine feet high, with long lance-shaped leaves, and a rhizome with long fleshy fibres, which lies near the surface of the ground. The seed-pods are about half an inch in length, three sided, obscurely rounded at the ends, longitudinally wrinkled, and of a buff color. The seeds are small, brown, irregular, and rough upon the surface, and easily reduced to powder. The odor of cardamoms is fragrant, the taste warm, pungent, aromatic, and somewhat terebinthinate. Its virtues depend upon a volatile oil which is obtained by distillation from the seeds. They also contain a fixed oil.

HISTORY.—Cardamom is mentioned as a medicine by Hippocrates and Dioscorides, the latter of whom states that it grows in India, and speaks of it as a remedy for epilepsy, sciatica, paralysis, sprains, colic, worms, &c. &c. But Matthioli gives many reasons which appear satisfactory, against believing this medicine to be the officinal cardamom of the present day,¹ while Mr. Adams thinks there is no reason for doubting that it is so.² Undoubtedly neither the Asiatics, among whom the plant is native, nor the European physicians who have lived and practised among them, attribute to cardamom any other virtues than belong to stomachic stimulants in general.

USES.—Cardamom is a warm and agreeable carminative and stomachic, which is well adapted to form an addition to tonic and stimulant preparations. The compound tincture, on account of its brilliant red color, imparted by cochineal, as well as from its active properties, is a favorite remedy for flatulent colic, when mixed with hot water and sweetened. Among the medicines of its class none is perhaps superior to it in acceptableness to the palate, as well as to the stomach.

ADMINISTRATION.—Cardamom may be administered in an *infusion* made with from two to four drachms in a pint of boiling water, and given in the dose of a wineglassful. In Germany white wine is some-

¹ Comment. sur Dioscorides, i. 5.

² Commentary on Paul. Ægin., iii. 157.

times used instead of water as a menstruum. There is a *simple tincture* (TINCTURA CARDAMOMI) and a compound (TINCTURA CARDAMOMI COMPOSITA), either of which may be prescribed in doses of one or two fluidrachms.

CARUM.—CARAWAY.

DESCRIPTION.—Caraway seeds, as they are commonly called, are the fruit or mericarps of *Carum carui*, a small biennial umbelliferous plant which grows wild in Europe, and is also cultivated there and in this country. They are of a brownish color, from one to two lines in length, pointed at either end, slightly curved inwards, with a convex back, flattened sides, and marked with five yellowish longitudinal ridges. They have an aromatic smell, and a warm, spicy, and somewhat bitter taste. These qualities are derived mainly from an essential oil, which, when first distilled, is colorless, but becomes darker, and finally brownish by age. It is soluble in alcohol and ether, but only slightly so in water.

HISTORY.—Caraway is described by Dioscorides, who attributes to it diuretic and stomachic properties like those of anise.¹ The same qualities are ascribed to it by Galen, Paulus, and the Arabians, one of whom adds that it possesses anthelmintic virtues.² Pliny states that it derives its name from its native country, Caria, and that it is chiefly used in the culinary art.³

ACTION AND USES.—Mitscherlich found that oil of caraway is a strong poison for rabbits; half an ounce of it destroying life in the course of five hours. The death of the animals was preceded by increased frequency of the pulse and respiratory movements, loss of sense and motion, and death by gradual asthenia. No structural changes existed in the primæ viæ, but the odor exhaled from the peritoneal cavity indicated the absorption of the oil.

Caraway is more used by the confectioner than by the physician; but it may be employed whenever a gastric stimulant or a carminative is required. An infusion, and a water of caraway, may be prepared in the same way as those of anise and fennel-seed, and the oil may be applied, like that of cloves, to assuage the pain of toothache when the nerve pulp of the tooth is exposed, or be taken in ether, Hoffmann's anodyne, or sweetened water, in doses of from one to ten drops.

¹ Mat. Med., lib. iii. cap. lvii.

² EBN BAITHAR, ii. 368.

³ Hist. Nat., xix. 49.

CORIANDRUM.—CORIANDER.

DESCRIPTION.—*Coriandrum sativum* is a small, annual, umbelliferous plant, a native of Asia Minor, and Southern Europe. The fruit, or coriander seed, as it is usually called, is spherical, about two lines in diameter, of a grayish-brown color, ribbed, and formed by the junction of two half fruits. It has when dry an aromatic and somewhat sweetish smell, and a similar taste. Coriander seeds furnish an essential oil, which is very liquid, colorless, and of the same taste and smell as the dried seeds.

HISTORY.—Hippocrates regarded coriander as stimulant and stomachic, but Dioscorides declares it to be sedative. Hence he says that mixed with cataplasms it is a useful application to erysipelatous parts and herpetic ulcers, carbuncles, scrofulous swellings, and all active inflammations. These remarks seem to apply to the herb, for it is added that the fruit (seeds) macerated in wine is anthelmintic, and promotive of the spermatie secretion, and that if too much of it is taken, the mind may become disturbed.¹ He states further that coriander is readily recognized by its smell (which Matthioli compares to that of bed-bugs, and hence, indeed, its name, from *κρίης*, cimex), and that a decoction of it may produce a delirium resembling that of drunkenness. For those who are under its influence talk indecently, and reveal what poison they have taken by the odor exhaled from their persons.² Galen seems to have been much irritated by the opinion of Dioscorides as to the sedative and disorienting properties of the plant, and, indeed, characterizes it bluntly as false. He, however, explains it by a reference to the astringent qualities of the plant, which, he admits, are competent to produce the effects ascribed to them by Dioscorides. But, he says, at the same time, that it is not at the height of inflammation that coriander, or any similar application, can do good, but only when the inflammatory process having declined, stimulants are required to restore the normal action of the part. The Arabian writers are altogether with Dioscorides and against Galen in this argument, although most of them, like Avicenna, admit the medicine to possess a transient stimulant operation. Rhazes and Hobaisch speak of its expressed juice as a poison, and the latter mentions pains, anxiety, syncope, and constriction of the throat, among the symptoms it produces. Elgâfaki also mentions delirium, disturbance of the memory and understanding, and usually sleep, as consequences of an overdose of it, and he includes

¹ Mat. Med., iii. 62.² Ibid., vi. ix.

it in the same group with opium and cicuta.¹ In modern times Hoffmann has stated, on the faith of some monks, that it is capable of producing intoxication.² Whatever degree of truth there may be in these accounts, which seem to refer exclusively to the herb and not to the seeds of coriander, there is no reason to suppose that the latter possess any qualities but those of the carminative aromatics.

ACTION AND USES.—Coriander-seeds appear to be simply aromatic and stimulant. They are seldom employed in medicine, except as a corrective to purgative medicines which are apt to gripe. For this purpose they form an ingredient of the *confection of senna*, the *tincture of rhubarb and senna*, the *tincture of senna and jalap*, &c. The dose of coriander is from half a drachm to a drachm.

CUBEBA.—CUBEBS. Vid. *Diuretics*.

CYMINUM. *Lond.*—CUMIN.

DESCRIPTION.—Cumin is the fruit (*cumin-seeds*) of *Cuminum cyminum*, a small annual plant which is a native of Egypt and Asia Minor, but is cultivated in Southern Europe, especially at Malta. The fruit is formed of two oblong mericarps, or half fruits, united by their flat sides, pointed at both ends, and marked by longitudinal ridges, which are furnished with fine prickles. It resembles caraway, and still more anise, but is rather larger than either. The color of cumin is grayish brown. Its odor and taste are very strong and aromatic, but less agreeable than those of anise. It yields a volatile oil in great abundance, of a light yellow color.

HISTORY.—Cumin was anciently a favorite condiment and medicine, and is spoken of in both senses by Hippocrates, Dioscorides, and Pliny. Hippocrates bestowed upon it the title of "royal." Dioscorides describes a cultivated and a wild variety of cumin, and says that it is astringent, styptic, stimulant, carminative, and diuretic.³ Pliny pronounces it to be, of all condiments, the best adapted to remove distaste for food,⁴ and states that it is among the most used of stomachic remedies, dispelling phlegm and flatulence, relieving colic and nausea, and dissipating hysterical symptoms, &c. He alludes to a singular property ascribed to this plant, that of making pale those who continue to take it. The Roman students of his day were accustomed, he says, to em-

¹ EBN BAITHAR, ed. cit., ii. 372.

³ Mat. Med., iii. lix. lx.

² MURRAY, App. Med., i. 405.

⁴ Hist. Nat., xix. 47.

ploy it for this purpose, in order that they might have credit for greater devotion to their studies than they deserved.¹ Galen says that its properties are like those of anise and of caraway. The Arabians repeat the observations of Dioscorides, but dwell particularly upon the efficacy of the medicine in passive hemorrhages.

ACTION AND USES.—Cumin has the same mode of action as caraway. It is used by the Dutch to season their cheeses, and by the Germans in some kinds of bread. It may be substituted for the other stimulants of its class in the cases to which they are applicable; it is, however, very seldom prescribed in this country. In Germany the oil has sometimes been used as an antispasmodic, and in England a plaster made with cumin, caraway, laurel, and Burgundy pitch is employed as a discutient and resolvent.

FÆNICULUM.—FENNEL-SEED.

DESCRIPTION.—Fennel-seed is the fruit of *Fœniculum officinale* and *F. vulgare*, the former being the common species in Italy, the latter in Germany. Another kind of fennel, *F. dulce*, is a native of Spain. Fennel has become naturalized, and is cultivated in other parts of Europe, and also in this country. It is an umbelliferous plant, and its seeds or half fruits are oblong, flat on one side, convex on the other, five-ribbed, and of a dark grayish-green color. It has a fragrant smell, and a sweet and aromatic taste. The properties of fennel-seed depend upon an essential oil of a light color and agreeable flavor.

HISTORY.—Fennel-juice and the root and seeds are frequently mentioned in the Hippocratic treatises as remedies for jaundice, and as means of promoting the secretion of milk, the lochial discharge, &c. Dioscorides, besides ascribing to them these and other virtues, says that a decoction of the tops is diuretic, and an infusion in cold water arrests vomiting.² Both he and Pliny describe a wild and a cultivated variety. The last-named author states, among other things, that fennel was an ingredient of most of the compound condiments of his time, and that then, as is now the custom, especially in Germany, the seeds were strewn over the surface of bread and cakes. He mentions that it is much esteemed in diseases of the lungs and liver; that a decoction of the root is diuretic, discutient, and alexipharmic; that the whole plant is aphrodisiac, &c.³ Galen repeats the same statements, and adds that it promotes the lacteal secretion, and is an emmenagogue. Arabian

¹ Hist. Nat., xx. lvii.

² Lib. iii. chap. lxvii. lxviii.

³ Hist. Nat., xx. xcv.

writers state that the seeds are more heating than the leaves, but that the latter possess a more anodyne virtue, and that the curative powers of the root excel those of the other parts. Avicenna says that it quickens the digestion; and, according to others, a decoction of the seeds, besides being carminative, has also expectorant virtues, and relieves dysuria.¹

ACTION AND USES.—The operation of fennel-seed is the same as that of the carminatives generally. It stimulates the digestive function, and, according to Mitscherlich, increases the renal, cutaneous, and mucous secretions, and also that of the milk. Six drachms of the volatile oil were required to destroy a rabbit; and the animal perished after symptoms of distress, followed by general insensibility and loss of muscular power. It discharged urine frequently and abundantly.

Besides being used, like other stomachic stimulants, for the relief of flatulent colic and nausea, in which cases it is sometimes associated with magnesia or bicarbonate of soda, fennel is often prescribed along with laxative medicines, in order to prevent their griping. German physicians employ it in slight catarrhal affections of the bronchia, and administer it to nursing-women to increase the secretion of milk.

ADMINISTRATION.—The preparation of fennel-seed most frequently employed is the *infusion*, made with two drachms of the seed to half a pint of boiling water, and administered in doses of one or two teaspoonfuls to an infant, and of a wineglassful to an adult. *Fennel-water* may be prescribed in the same doses as the infusion. The *volatile oil* is sometimes employed in doses of from one to five or ten drops, on sugar or suspended in some appropriate vehicle.

G A U L T H E R I A .—P A R T R I D G E B E R R Y .

DESCRIPTION.—The leaves of *Gaultheria procumbens*, a native plant of North America, growing in sandy soils from Canada to Georgia. Various popular names have been given it, such as Winter-green, Partridge-berry, Mountain-tea, Deer-berry, Chieker-berry, &c. It is a small, indigenous, evergreen plant, with ovate, shining, and coriaceous leaves, and white, bell-shaped, or ovate flowers, which are succeeded by fleshy scarlet berries, containing many seeds. Every portion of the plant has a peculiar aromatic taste and smell which have been compared to those of orange flowers, and which are associated with astringency in the leaves, and some sweetness in the fruit. The former

¹ EBN BAITHAR, ed. Sontheimer, i. 486.

qualities appear to depend upon a volatile oil (*oleum gaultheriæ*), which is the heaviest of all the essential oils, having the sp. gr. 1.173. When fresh it is colorless, but it becomes yellowish or brownish by time. It has a sweetish, but burning and aromatic taste, and the peculiar odor of the plant.

ACTION AND USES.—*Gaultheria* is stimulant, aromatic, and somewhat astringent, a combination of qualities which have led to its being compared to cinnamon. A case is quoted by Beck,¹ of a number of soldiers at Quebec, poisoned by a tea made of *andromeda*, *gaultheria*, and *ledum*. It produced vertigo, weakness, vomiting, cold sweats, and in one case insensibility. Dr. Gallagher records the case of a boy nine years old, who, after taking about half an ounce of the oil of *gaultheria*, was seized with severe vomiting, purging, epigastric pain, hot skin, frequent pulse, slow and labored respiration, dulness of hearing, and an uncontrollable desire for food. He continued very ill for several days, but in two weeks had recovered his health.² In the dose of an ounce it is said to have several times been fatal. The leaves of *gaultheria* have been at times employed by the country people as a substitute for tea, and they are extensively used in domestic medicine to prepare an infusion which is given in chronic bowel complaints, and as an emmenagogue. Physicians more frequently prescribe the oil to conceal the taste of nauseous medicines. It gives its peculiar flavor to the compound syrup of *sarsaparilla*. It may be used for the same purposes as the other essential oils already mentioned, and particularly as a carminative; but it is less grateful to the stomach than other articles of its class.

HEDEOMA.—AMERICAN PENNYROYAL.

DESCRIPTION.—The herb of *Hedeoma pulegioides*, an indigenous annual plant abounding in dry sterile places in all parts of the United States. It is about a foot high, much branched, with small, opposite acutely oval or oblong-lanceolate leaves, which are somewhat rough and pubescent. The flowers are axillary, very small, and of a pale blue color. The whole herb contains a volatile oil which diffuses for some distance its powerful aromatic odor, which is still very strong even in the dried state of the plant. Pennyroyal imparts its virtues to hot water, but more fully to alcohol; they depend upon the oil,

¹ Med Jurisp., 10th ed., ii. 885.

² Phil. Med. Examiner, viii. 347.

which may be procured by distillation. It is of a light yellow color when recent, and has a specific gravity of 0.948.

ACTION AND USES.—Pennyroyal is a stimulant aromatic, and may be used to relieve nausea from unwholesome food, or flatulent distension of the primæ viæ and the colic dependent upon it. It may also be employed to flavor purgative and other draughts which tend to gripic or to excite nausea. Emmenagogue virtues are popularly attributed to it, and of these it possesses as much as, if not more than, other herbs of its class. In warm infusion it often succeeds in bringing on the menstrual discharge when it is delayed by temporary causes and particularly by the operation of cold. A warm foot or hip-bath should be prescribed at the same time. In like manner, by a stimulant operation, warm pennyroyal tea is often an efficient diaphoretic remedy in the forming stage of catarrh and of muscular rheumatism. The *infusion*, made with half an ounce of the plant to a pint of water, may be given in doses of two or more fluidounces every hour. The *volatile oil* (OLEUM HEDEOMÆ) may be used internally for the same purposes as the plant; in doses of from two to ten drops, or externally as an ingredient of rubefacient liniments. It is said to have been sometimes employed for the purpose of producing abortion, but we are acquainted with no well authenticated case of its attaining this object.

European pennyroyal (MENTHA PULEGIUM) is identical in action with peppermint, but as its odor and taste are not so agreeable, it is much less used. (*Neligan.*)

LAVANDULA.—LAVENDER.

DESCRIPTION.—*Lavandula vera* whose flowers form the official medicine under consideration, is a small shrub which is a native of Southern Europe and the North of Africa, but is cultivated as a garden plant all over Europe and this country. Its main stem is woody, but terminates above in numerous herbaceous, erect, quadrangular branches, which are furnished with many linear leaves. The flowers, which are in spikes, are of a purplish-gray color, and have a powerful but refreshing aroma, and a warm, bitter aromatic taste. These qualities depend chiefly upon an essential oil, which is obtained by distillation, and is associated with a bitter principle and with tannic acid.

HISTORY.—The name of this plant is of Italian origin, and that under which it was employed by the ancients is unknown. Matthioli, however, describes it by the name of Nardus Italicus, and says that it is used as a remedy for epilepsy, apoplexy, spasms, and paralysis;

that it also is stomachic, and strengthens the liver and spleen, and is emmenagogue and ecbotic, diuretic, and carminative. He further speaks of the peculiarly penetrating odor of its essential oil.¹ Alston repeats the same list of virtues attributed to this plant.²

ACTION AND USES.—It is asserted that lavender flowers, in large doses, occasion colicky pains and excite the circulatory system. Strumpf states that a drachm of the volatile oil of lavender given to a rabbit, caused the animal to utter loud cries, and breathe hurriedly, and presently to die in convulsions, without any trace of a local action of the poison remaining in the stomach.³

Lavender alone is hardly ever employed as a medicine; the only use to which it is applied is for scenting clothes by scattering the spikes among them, or placing the flowers inclosed in muslin bags in the usual receptacles of clothing. The *oil of lavender* (OLEUM LAVANDULÆ) may be given internally in doses of four or five drops to allay nervous agitation or relieve nervous headache. The *spirit of lavender* (SPIRITUS LAVANDULÆ), made by distilling alcohol from the flowers, or by dissolving the oil in alcohol in the proportion of a fluidounce of the former to a gallon of the latter, is used for the same purposes occasionally, but much more frequently as a refreshing perfume in the sick-room, or as an article for the toilet. The *compound spirit of lavender* (SPIRITUS LAVANDULÆ COMPOSITUS) is an old and famous medicine of the English Pharmacopœia. It originally contained as many as thirty ingredients, but is now made by digesting cinnamon, cloves, nutmeg, and red saunders in a mixture of the spirit of lavender and spirit of rosemary. It is a popular and very efficient remedy for flatulent colic, and for gastric uneasiness, and the accompanying general depression produced by laborious digestion. It may be added to bitter tonic infusions to increase their efficacy and to correct their taste. The dose is a fluidrachm.

MELISSA.—BALM.

DESCRIPTION.—*Melissa officinalis*, a native of the South of Europe, is an herb from one to two feet high, consisting of several quadrangular stems rising from a perennial fibrous root. The upper leaves are pubescent and ovate, the lower, cordate. The flowers, which are grouped on short axillary peduncles, are white or yellow. Balm has a peculiar fragrance in the fresh state, which has been compared to

¹ Liv. i. chap. vi.

² Lectures, ii. 159.

³ Handbuch, i. 633.

that of lemons; but it is nearly inodorous when dry. The taste is slightly aromatic and bitterish. Its qualities depend upon an essential oil which has the peculiar smell and taste of the fresh plant in a high degree. It also contains bitter and astringent principles.

HISTORY.—Dioscorides derives the name of this plant from the fact that bees are very fond of its flowers, and make the best honey (μέλι) from them. He speaks of the virtues of the bruised leaves when applied to the stings of insects, &c., of fomentations made with them to provoke the menstrual discharge, of the tea as a mouth-wash for tooth-ache, &c.¹ The Arabians attributed wonderful virtues to this simple herb. Avicenna declared that it possesses an astonishing power of cheering and strengthening the heart. Its perfume, and its attenuating and astringent properties, render it peculiar. They do good to all the organs, clearing the brain, and purifying the blood, and are serviceable in all atrabilious and mucous disorders. When chewed, the leaves sweeten the breath and allay thirst; they also quicken digestion, and relieve nausea and faintness. Another writer says that balm dispels drowsiness, and expels flatus from the stomach and bowels. But, as if to throw doubt upon such opinions, another Arabian author gravely assures us that among its surprising qualities is this—that if its root, leaves, and seeds inclosed in a bag are worn about the person, they will form an amulet to secure the affections of one's friends, to make all his undertakings succeed, and to render him joyous and happy so long as he wears it.²

USES.—Balm tea is a popular and most refreshing drink when made from the fresh plant and taken cold; and the hot infusion of the dried plant is one of the mildest that can be used to assist the operation of diaphoretic medicines. It may be made with from half an ounce to an ounce of the herb in a pint of water.

MYRISTICA.—NUTMEG.

MACIS.—Mace.

DESCRIPTION.—Nutmeg is the kernel of the fruit of *Myristica moschata*, a native tree of the Molucca Islands, but now cultivated on the Indian continent and the adjacent islands, in the West Indies, and South America. It is a handsome tree of from twenty to thirty feet in height, with leaves bright green upon their upper surface and whitish beneath,

¹ Op. cit., lib. iii. ch. c.

² EBN BAITHAR, ed. Sontheimer, i. 109.

and pale yellow flowers, of which the male and female grow upon different trees. Three crops of the fruit are said to be produced annually in the Moluccas. It is about the size of a peach, yellow when ripe, and as its fleshy part dries it divides in the middle, disclosing a thin brown shell enveloping the kernel, surrounded by a yellowish-brown and reticulated membrane (arillus), which is the *mace* of commerce. The nutmeg, or kernel, is of rounded oval shape, depressed at either end, of a grayish-brown color, and marked by irregular furrows. Internally the surface of a section is lighter in color than the outside, but is traversed by reddish veins which contain an essential oil. Owing to this oil nutmeg is not easily pulverized, but may be readily crushed or cut. Its odor is strong, aromatic, and grateful, and its taste is oily, warm, and acrid.

The constituents of nutmeg are mainly a *volatile* and a *fixed oil*. The former is obtained by distillation with water, is colorless or pale yellow, of a viscid consistence, and has the odor and taste of nutmegs. It is, however, separated into two oils, one of which is lighter and the other heavier than water. The fixed oil is procured by subjecting a paste of nutmegs to heat and pressure. It is an orange colored soft-solid, having the peculiar odor of the volatile oil.

HISTORY.—It does not appear probable that the Greeks or Romans were acquainted with nutmegs or mace. The earliest account which we possess of them is contained in the writings of the Arabian physicians; in these reference is made to the Indian origin of the nutmeg. Avicenna states that it is useful in impaired vision, and dysuria, that when mixed with oil it is anodyne, and also in pessaries, and that it stops vomiting. Rhazes says that it is good for the stomach and liver, and Isaac Ben Amrân that it is carminative, and is useful in various spots and eruptions on the skin. In general, according to another writer, it strengthens and warms the relaxed stomach and cures diarrhoea depending 'upon atony of the intestines, &c.'¹ In the Molucca Islands and on the continent of India it is considered one of the most valuable medicines in dyspeptic complaints and in all cases requiring cardiacs and corroborants; they likewise prescribe it to such puny children as appear to suffer much in weaning.²

ACTION. *On Animals*.—Mitscherlich, who administered the volatile oil of nutmeg to rabbits, found that six drachms proved fatal in thirteen hours and a half. The following were the principal symptoms produced by it: Increased activity and force of the circulation, rest-

¹ PAULUS ÆGINETA (Syd. Soc. ed.), iii. 436, EBN BAITHAR, i. 269.

² AINSLIE, Mat. Ind., i. 249.

lessness, followed by muscular weakness, bloody, strong-smelling urine, then diminished action of the heart, labored breathing, coldness, and death without convulsions.¹

On Man.—Bontius states that nutmeg has a narcotic property, and that he had seen persons unaccustomed to its use lie immovable and speechless in consequence of having eaten too largely of it.² Cullen relates the case of a person who having taken by mistake two drachms or a little more of powdered nutmeg, was seized with drowsiness which increased to stupor and insensibility, followed by delirium. These symptoms continued for six hours.³ Purkinje took a nutmeg fasting, piecemeal and with sugar. The whole day long his senses were dull and his limbs heavy, his mind was not disturbed, but a glass of wine after breakfast affected him unusually. One afternoon, after he had taken three nutmegs, he immediately fell asleep and passed between two and three hours in a dreamy but pleasant state. At the end of this time he went out, and, although he had full command of his muscles, his dreamy, half-unconscious state continued. For several days afterwards wine excited him in an unusual degree.⁴ Ainslie mentions that although mace is a favorite medicine with the Hindoo doctors, they generally administer it cautiously, from having ascertained that an overdose is apt to produce dangerous stupor and intoxication.⁵ Pereira was acquainted with a case in which the narcotic effects of a whole nutmeg had been several times experienced.⁶ It does not appear to have proved fatal in any case. The volatile oil acts locally as a mild rubefacient.

USES.—Nutmeg is very little employed as a medicine, but almost wholly as a condiment for preparations of milk and farinaceous substances. In Germany it is frequently used to promote the digestion of oleraceous plants, particularly cabbage and cauliflower. Mace is still more commonly employed to season food, and especially soups and pastry. Powdered nutmeg may be given in cases of simple debility of the stomach in the same manner as other aromatics, and in doses of from five to twenty grains. The *volatile oil* (OLEUM MYRISTICÆ) may be prescribed in the dose of two or three drops; and *spirit of nutmeg* (SPIRITUS MYRISTICÆ) in doses of one or two fluidrachms. They are used chiefly for the purpose of flavoring medicines. The oil, however, on account of its rubefacient action, is sometimes applied externally by friction, either alone or as an ingredient of stimulating liniments.

¹ Arzneimittellehre, ii. 184.

³ Mat. Med., ii. 204.

⁵ Op. cit., i. 201.

² De Med. Indorum, p. 47.

⁴ WILMER, Wirkung, &c., iii. 308.

⁶ Mat. Med., 3d Am. ed., ii. 415.

MENTHA PIPERITA.—PEPPERMINT.

DESCRIPTION.—Peppermint is the herb of *Mentha piperita*, a small perennial plant, which is largely cultivated in England and in this country. It is also found on the continent of Europe, but of inferior quality. It has an upright and smooth stem; dark-green, smooth, opposite, petiolate, ovate-oblong, and serrate leaves; numerous purple flowers, arranged in terminal obtuse spikes, interrupted at the base. The odor of peppermint is very strong and pungent, and it has a hot and somewhat bitter taste, which is followed by a sense of coolness when the breath is drawn rapidly into the mouth. These qualities are very feeble in the dried herb, and they depend upon a *volatile oil* which abounds in the fresh plant, and is obtained by distillation with water. When recently prepared it is colorless, but it acquires a faint green tinge and then becomes reddish by age. Besides this oil, peppermint also contains a crystallizable stearoptine or peppermint-camphor, and a fatty oil capable of becoming rancid.

HISTORY.—Several species of mint were used by the ancients, one of which, called Ἡδύσμον, is generally believed to be *Mentha sativa*, L., but *M. piperita* is supposed to be a native of England. Guibourt states that the older botanists of the continent, as Bauhin, Geoffroy, &c., make no mention of it, but that it abounds and is much used in China.¹ Dioscorides and the Arabians describe at great length the virtues of many kinds of mint, but none of them are thought to be the present officinal species.

ACTION AND USES.—The action of peppermint is that of a simple carminative stimulant. An *infusion* of the fresh herb, made in the proportion of half an ounce to a pint of boiling water, may be given in doses of a wineglassful, in cases of flatulent colic, but for this purpose the *essence of peppermint* (TINCTURA OLEI MENTHÆ PIPERITÆ) is preferable, in doses of from five to twenty drops mixed with a wineglassful of hot water, and sweetened. This remedy for the painful affection referred to, is almost universally employed in domestic practice. Infantile cases are often treated by applying the fresh bruised herb to the abdomen. A similar application is often very efficient in cases of cholera morbus in children and even in the adult. The tincture of oil of peppermint is made by dissolving two ounces of the oil in a pint of alcohol.

According to M. Pidoux, the warm infusion of peppermint is

¹ Hist. des Drogues Simples, ii. 426.

remarkably efficacious in dysmenorrhœa, attended with chilliness, pandiculation, muscular and especially rending uterine pains. Young chlorotic females are, also, he remarks, subject to gastralgia and enteralgia after meals, which are relieved by this infusion; and it also, if taken in the interval between meals, prevents such attacks. Nervous headaches, palpitations of the heart, hiccup, &c., are often dissipated by its means. This writer recommends it as an ordinary drink in typhoid affections, in the cold stage of Asiatic cholera, and in other excessive fluxes.¹

Peppermint water (AQUA MENTHÆ PIPERITÆ) is made by dissolving half a fluidrachm of oil of peppermint in two pints of water by the intervention of carbonate of magnesia. It contains nearly a minim of the oil in each ounce of water. It is used as a vehicle for many medicines that tend to produce nausea or to gripe, and may be prescribed in doses of three fluidounces or less. But it is much less acceptable to the stomach than spearmint water.

Peppermint lozenges (TROCHISCI MENTHÆ PIPERITÆ), made with oil of peppermint, sugar, and mucilage of tragacanth, are used to relieve flatulence and colic, and to prevent sea-sickness. This and the other preparations of peppermint are apt to excite gastric pain in persons who are well and who partake of them immoderately.

MENTHA VIRIDIS.—SPEARMINT.

DESCRIPTION.—Spearmint is the herb of *Mentha viridis*, an herbaceous perennial plant, a native of the milder parts of Europe, of Africa, and America, flourishing best in a moist soil. It has an erect, smooth stem, and lanceolate, subsessile, unequally serrated leaves of a light-green color. The flowers are purplish, and arranged in elongated pointed spikes. Its smell and taste are less intense than those of peppermint, and to most persons they are more agreeable. They depend upon a volatile oil, which is much less abundant than in peppermint.

USES.—Spearmint is employed medicinally for the same purposes as peppermint, and exhibits the same powers in a lower degree.

The officinal preparations of this medicine are the *volatile oil* (OLEUM MENTHÆ VIRIDIS), of which the dose is from one to six drops; the *essence of spearmint* (TINCTURA OLEI MENTHÆ VIRIDIS), of which from ten to forty drops, properly diluted, may be given at a dose; and *spear-*

¹ Thérapeutique, 5ème éd., ii. 475.

mint water (AQUA MENTHÆ VIRIDIS), which may be prescribed in teaspoonful or larger doses. The last-mentioned preparation is the only one much used, and chiefly as a vehicle for medicines of an unpleasant taste, or which are apt to nauseate.

MONARDA.—HORSEMINT.

DESCRIPTION.—Monarda is the herb of *Monarda punctata*, an indigenous herbaceous plant found in light sandy soils from New Jersey to Florida. Its stems are from one to three feet high, obscurely quadrangular, whitish, and downy. The leaves are oblong lanceolate, smooth, serrate, punctate, and tapering to a short footstalk. The flowers are yellow spotted with brown, disposed in numerous whorls, and having lanceolate colored bracts extending beyond the whorls. The whole herb contains a volatile oil, on which its virtues depend, and it has a strong aromatic odor, and a warm, pungent, bitterish taste. The oil is of a reddish amber color, and has an exceedingly pungent smell and taste.

ACTION AND USES.—Horsemint was first brought into notice as a medicine by Dr. E. A. Atlee in 1819.¹ He states that it was popularly regarded as a diaphoretic, diuretic, and carminative, and that its volatile oil is a powerful irritant, and even capable of vesicating the skin.

The warm infusion of horsemint is an excellent diaphoretic in recent and mild cases of rheumatism and bronchitis, and, like other medicines of its class, occasionally proves emmenagogue. Elliott attributes this latter quality especially to the root. The cold infusion is said to have diuretic qualities.

The essential oil, pure, or diluted with alcohol or tincture of camphor, was used by Dr. Atlee as a liniment for chronic rheumatism and various local pains, in hemiplegia and other forms of paralysis; and in one case of deafness, of several months' duration, hearing was restored by bathing the scalp with the undiluted oil. He believed it to be of great service as a stimulating embrocation in the low stage of epidemic typhus, and in the advanced period of cholera infantum, when rubbed upon the abdomen. Dr. Eberle also found this latter application serviceable in allaying gastric irritability and arousing the powers of life.

ADMINISTRATION.—An *infusion* of horsemint, made with half an ounce of the herb and a pint of water, may be prescribed in wineglassful doses. Of the *volatile oil* two or three drops may be given internally,

¹ Am. Med. Recorder, ii. 496.

mixed with sweetened water. As a rubefacient the oil should be diluted with from two to four parts of olive oil or of soap liniment, unless an immediate and powerful impression is required. In that case it may be applied pure.

ORIGANUM.—COMMON MARJORAM.

DESCRIPTION.—*Origanum vulgare* is a native perennial plant of Europe, Asia, and America, and grows wild in bushy places on a calcareous or gravelly soil. It is from one to two feet high, with an erect, purplish, villous, four-sided stem, and opposite, ovate, entire, somewhat hairy leaves, of a yellowish-green color on both sides. The flowers are purplish, in oblong, paniced spikes, with ovate reddish bracts longer than the calyx. The plant has a peculiar aromatic odor, and a warm, pungent taste, which are due to a volatile oil, besides which it yields tannic acid and a bitter principle.

ACTION AND USES.—Like the other members of its class, origanum is stimulant, carminative, diaphoretic, or emmenagogue, according to the conditions under which it is employed. In Europe, where it is more used than in this country, the infusion is prescribed for the purposes mentioned, and also as a stimulant in chronic bronchial affections. The *essential oil* is a powerful irritant, and may be resorted to in all cases in which a stimulant and rubefacient action upon the skin is required. It is applied on cotton to relieve pain in hollow carious teeth, and, mixed with oil or camphorated soap liniment, may be used as an embrocation in neuralgic and rheumatic affections, sprains, and bruises, in paralysis with wasting of the muscles, and for promoting the growth of hair in cases of alopecia.

PETROSELINUM, vid. *Diuretics*.

PIMENTA.—PIMENTO.

DESCRIPTION.—Pimento is the name given to the dried unripe berries of *Myrtus pimenta*, a tall and beautiful evergreen tree of the island of Jamaica. Its foliage is very dense, and the leaves are about four inches long, of a deep shining green color, elliptical, and veined. The flowers are numerous, small, of a greenish white color, and are arranged in terminal panicles. The fruit is a dark purplish, two-seeded berry, crowned with a persistent calyx, smooth, shining, succu-

lent, and containing two uniform flattened seeds. When dry, and as found in commerce, the berry is about the size of a pepper-corn, brown, dull, rough, and umbilicated at the summit. The taste of pimento is very strong and agreeable, and its smell, which has some resemblance to that of cinnamon, cloves, and nutmeg together, has procured for it the popular name of *allspice*. It is also called *Jamaica pepper*, in reference to its origin.

The virtues of pimento depend chiefly upon its essential oils. Of these one is *volatile*, and the other *fixed*. The former is very abundant, constituting about six per cent. of the dried berries, and possesses all the active properties of oil of cloves. The fixed oil has a greenish color, a rancid odor, and an acrid, burning taste.

ACTION AND USES.—Pimento is an aromatic stimulant, and, like other substances of its class, is used as a condiment to stimulate the digestive organs when they are suffering from exhaustion, and particularly from that debility caused by the prolonged heats of summer in tropical regions. In medical practice it is chiefly prescribed to relieve flatulence, to augment the effect of vegetable tonics, and to correct the tendency of several purgatives to produce griping, or the nauseous taste of various medicines.

PIPER.—BLACK PEPPER.

DESCRIPTION.—Black pepper is the dried, unripe berry of *Piper nigrum*, a perennial, climbing vine, which is a native of the East Indies, and is extensively cultivated on the Malabar coast, the Malay peninsula, in Java, Sumatra, and other islands. The berries, which are in long, tapering clusters, are round, about the size of a pea, at first green, then red, and afterwards black.

As found in commerce the unripe berry is nearly black, and shrivelled. Internally there is a white kernel, which is hard without, but farinaceous in the centre. It has the hot, biting, pungent taste with which every one is familiar. A variety, known as white pepper, is made from the ripened berry, by soaking it in water, and then removing the exterior dark pulp by friction. But in this process a portion of the active properties of the berry is lost. These depend chiefly upon a crystallizable principle called *piperin*, an acrid resin, and a volatile oil.

Piperin was discovered by Ørsted, in 1819, and regarded by him as a halogen body, and as the cause of the peculiar taste of pepper. Pelletier alleged, however, that this substance, when pure, is devoid

both of taste and smell, and is related to the resins rather than the alkalies. The latter opinion is the one now generally accepted, although Dr. Christison's examination of piperin agrees in its results with those of Ærsted. This substance is obtained in colorless rhombic crystals, insoluble in water, but soluble in alcohol. The *acrid resin*, or concrete oil, is liquid at a little above the freezing point of water, has an exceedingly pungent and acrid taste, and is soluble in alcohol and ether. The *volatile oil* is separable by distillation with water, is colorless when fresh, and has the odor and taste of pepper in a marked degree.

HISTORY.—Pepper was very anciently used as a medicine. It is repeatedly referred to in the Hippocratic writings, and mentioned as a stimulant expectorant, as adapted to quicken labor, &c. Theophrastus describes the round and the long species, and their calefacient operation, and also states that they are antidotes to hemlock.¹ Dioscorides mentions the Indian origin of pepper, but appears to confound *Piper longum* and *P. nigrum*. The former, he says, is the stronger of the two, and adds that black pepper has more virtues than white. All sorts, he remarks, are healing, diuretic, maturative, drawing, and resolvent, and remove obscurities of the cornea, and, both internally and externally employed, cure chills which precede periodical fevers, are antidotes to the bites of serpents, provoke the discharge of the dead fœtus, and prevent conception if applied by the female immediately after coition as a suppository in the vagina; they are useful in coughs and pulmonary complaints, relieve colic, and, when used as condiments, excite the appetite and improve digestion.² Celsus mentions both long and round pepper,³ as diuretics, and recommends drinking hot water with pepper to prevent the chill of intermittent fever.⁴ The use of peppers for the cure of intermittents is strongly recommended by Stephanus, in his Commentary on Galen.⁵ Rhazes speaks of pepper as unsuitable for warm, but as well adapted to cold temperaments, and warns against its use those who are affected with ulcers of the bowels, with ardor urinæ, or inflammations of the liver. Other Arabian writers recommend it as an application to carious teeth, for the relief of pain; as a remedy for alopecia, when the bald scalp is rubbed with a mixture containing it, along with salt and garlic; as an application in farinaceous poultices in some cutaneous eruptions, and mixed with drachylum plaster to discuss œdematous swellings, and allay flatulent distension of the bowels; with olive oil as a liniment for paralyzed and

¹ Hist. Plant., ix. xxii.

² Mat. Med., ii. cliii.

³ Book, ii. ch. xxxi.

⁴ Book, iii. ch. xii.

⁵ PAULUS ÆGINETA, Comment. (Syd. soc. ed.), iii. 295.

insensible parts; with astringent substances for the relief of micturition in persons of a cold, phlegmatic habit, &c.¹ Ettmüller, Bartholin, Ernestus, Kunrad, and Schroder, in the last century, furnished examples of the cure of intermittent fever by this medicine.² In some parts of Europe, also, an infusion of pepper in brandy was a popular remedy for this disease. The native doctors of India prescribe an infusion of roasted pepper to arrest vomiting in cholera, and prepare with it a kind of liniment which they suppose to have 'sovereign virtues in rheumatism.'³

ACTION AND USES.—Applied to the skin, powdered pepper occasions severe pain and redness; in the mouth and throat, in large quantities, it excites intense burning; and in the stomach a sense of diffusive warmth, with some acceleration of the pulse. In very large doses it appears sometimes to have produced alarming symptoms. Van Swieten relates that a man who had swallowed a large quantity of ground pepper was seized with a severe and dangerous fever; Wendt a case in which intestinal inflammation and delirium ensued; Lange one of a person who became delirious after taking two spoonfuls of pepper in wine; Jæger the case of a man who had taken from three to four drachms of pepper in a glass of brandy, and was soon afterwards found in convulsions; on recovering his consciousness, he complained of burning pain in the throat and stomach, was extremely thirsty, and vomited all the drink that he swallowed. In another case a young man took thirty white pepper-corns in brandy. Violent burning heat in the epigastrium, thirst, and rigors ensued. On the following day a pain, compared to the heat of a live coal, was felt in the region of the duodenum. For three days these symptoms continued, with constipation and fever, and in spite of the administration of several doses of sweet oil and an enema. A dose of castor oil was then given, after which the pain shifted its seat, and gradually subsided when the pepper-corns had been discharged.⁴ In treating intermittent fever with *piperin*, Chiappa observed that generally after its administration a burning sensation in the stomach, and sometimes in the throat, was complained of, and not unfrequently heat in the rectum and the whole abdomen; in two cases the eyes became injected, and the eyelids, lips, and nose were swollen.⁵

These cases prove, what daily observation also shows, that the action of black pepper is rather that of a local than a diffusible stimulant.

¹ EBN BAITHAR, ed. Sonthheimer, ii. 261.

² MURRAY, App. Med., v. 32; ALSTON, Mat. Med., ii. 312.

³ AINSLIE, Mater. Ind., i. 304.

⁴ WIBMER, Wirkung der Arzneim., iv. 218.

⁵ DIERBACH, Neueste Entdeck., ii. 354.

It stimulates the feeble digestion, and enables the stomach to appropriate food which, without its aid, would not be assimilated, and at the same time prevents the formation of flatus or provokes its discharge. Its local action upon the rectum led to its being anciently employed as a remedy for *hæmorrhoids*, and this practice has been imitated in modern times, first empirically in the form of *Ward's paste*, a nostrum which had great vogue in London, and subsequently by the compound confection of pepper (*Lond.*), of which Sir B. Brodie recommends a piece the size of a nutmeg to be taken three times a day, and he states that very severe cases of piles are sometimes cured by it.¹ In some cases of fistula in ano, of gleet, and of leucorrhœa, pepper has been found very serviceable; in the second of these affections, however, it is probably inferior to cubebs.

The treatment of intermittent fever by black pepper has already been mentioned as an ancient method of practice, and in modern times it has been revived by the use of piperin, and of pepper itself. In 1816, Louis Frank, of Parma, after having in vain endeavored to cure a tertian ague with bark and afterwards with opium, prescribed six pepper-corns to be taken twice a day, and afterwards increased the dose to nine. A cure was speedily effected. Afterwards he treated seventy persons affected with intermittent fever, and in the majority the disease was arrested after the second or third paroxysm. The cases of relapse were rare, more so than when bark was used.² In 1824, Miccoli, of Ravenna, Bertini, of Turin, Simonetti, of Pesaro, and Gordini, of Leghorn, used piperin successfully, the first in twenty-two cases, and the others in a smaller number.³ Riedmüller, of Nuremberg, is reported to have treated five hundred cases very successfully with this remedy.⁴ Dr. Hartle, of Trinidad, states that in the intermittents of that island he found piperin to eradicate the disease when quinia failed;⁵ and Dr. Blom considered this substance particularly applicable in cases which resist quinia, or which frequently relapse in spite of the use of this medicine.⁶ The preceding summary of the principal reports which have been published concerning the use of this medicine for the cure of intermittent fever leaves no doubt of its efficacy, and shows that it is not to be overlooked in the list of anti-periodic remedies. Probably its real value consists in its stimulant operation, and in that it is particularly applicable, on the one hand, to very mild cases of the disease, and, on the other, to those chronic forms which are

¹ Lectures (Am. ed.), p. 312.

² Journ. Complement., viii. 371.

³ Revue Méd., xiv. 294; xix. 313.

⁴ TROUSSEAU and PIDOUX, op. cit., 5ème éd., ii. 502.

⁵ Edinb. Med. and Surg. Journ., Jan. 1841.

⁶ DIERBACH, op. cit., ii. 331.

often sustained by want of tone in the system generally, and by debility of the digestive organs in particular. In such cases, as appears in the history of many tonic and stimulant medicines, any strong excitant is occasionally adequate to the cure. Under circumstances like those referred to, the association of black pepper with quinia or bark is probably more efficacious than the administration of either medicine alone.

ADMINISTRATION.—*Powdered pepper* may be given as a stomachic stimulant in doses of from five to twenty grains, or as a condiment freely mixed with the food. As an anti-periodic, eight or ten grains of *whole pepper* may be prescribed two or three times a day. The *ethereal fluid extract* (EXTRACTUM PIPERIS FLUIDUM), or the *oil of black pepper*, may be directed as a stimulant in doses of one or two minims, properly guarded in emulsion or pill. *Piperin* may be given in doses of from one to ten grains.

ROSMARINUS.—ROSEMARY.

DESCRIPTION.—*Rosmarinus officinalis*, the plant whose tops constitute this medicine, is a native of Europe near the shores of the Mediterranean, but it is cultivated in other European countries and in the United States. It is a small evergreen shrub with numerous erect branches, and opposite, sessile, linear leaves, smooth and green upon the upper surface, and white and downy beneath. The flowers, of a pale blue color, are gathered into small clusters in the axillæ of the upper leaves. The flowering tops have a strong and peculiar odor due to a volatile oil. They are eagerly sought as food for bees, and it is to them that the honey of Narbonne owes the flavor for which it is so justly famous.

The volatile oil is yielded by distillation of the fresh tops in the proportion of from one-fourth of one to one per cent. It is a transparent white or amber colored liquid, and sometimes even greenish, with the characteristic odor of rosemary, and an acrid, aromatic, and burning taste. On exposure to the air it deposits a large quantity of stearoptene.

HISTORY.—Rosemary was very anciently known, and employed in medicine. Theophrastus describes the stimulating properties of its herb and root, and ascribes to it emmenagogue, diuretic, and galactopoietic virtues.¹ To this account Dioscorides subjoins that it is discutient, is good for hæmorrhoids and other diseases of the anus, and

¹ De Nat. Plant., lib. ix. cap. xii.

relieves colic.¹ An Arabian writer, besides mentioning the virtues here attributed to the plant, states that it is carminative, removes obstructions of the liver and spleen, is also expectorant, and useful in cases of asphyxia, of dyspnœa, and dropsy.² Murray styles it one of the most potent aromatics of its class, in stimulating and sustaining the nervous system, and in dissipating and resolving swellings and indurations. He speaks of its remarkable power as a diaphoretic, emmenagogue, and carminative; says that it is justly esteemed in nervous disorders, such as loss of memory, vertigo, and paralysis; and adds that it is regarded as efficacious in humid asthma, and in strumous enlargement of the cervical glands.³ A distilled spirit in which rosemary is associated with lavender flowers, or with sage and ginger, has become famous under the name of *Aqua Hungarica*. It is a delightful perfume, but has also marvellous virtues attributed to it by the credulous.

ACTION AND USES.—According to Strumpf, the oil of rosemary is an active poison, even more so than oil of savine or of mustard. In the dose of a scruple it destroyed a rabbit after occasioning spasms.⁴ A case of death is recorded in a child three or four years old, from a mixture of six measures of this oil, and two of oil of wormseed, given in repeated doses of a tablespoonful.⁵

Rosemary is used medicinally to relieve colic, to promote menstruation, and allay slight nervous derangement depending upon debility. The oil is employed as an ingredient of ointments and liniments intended to be applied by friction to rheumatic or paralyzed muscles, to swellings left by inflammation, or produced by chronic scrofulous enlargement of the glands, to bruises, sprains, &c., and to the scalp to promote the growth of the hair. The vapor of the oil produced by rubbing a few drops between the palms of the hands, and then allowed to come in contact with the eyes, has been used with advantage in weakness of these organs from nervous exhaustion.

ADMINISTRATION.—An *infusion* of rosemary prepared with from two to four drachms of the plant to half a pint of water, may be prescribed in tablespoonful doses. The volatile *oil* is given in doses of from two to four drops. This preparation, and also the *spirit* (SPIRITUS ROSMARINI), are, however, seldom used internally, but they enter into the composition of various stimulant liniments and tinctures.

¹ Op. cit., lib. iii., cap. lxxii.

² EBN BAITHAR, ed. Sonthemier, i. 73.

³ App. Med., ii. 206.

⁴ Handbuch, i. 636.

⁵ U. S. Dispensatory, and Am. Journ. of Pharm., xxiii. 286.

RUTA.—RUE.

DESCRIPTION.—The leaves of *Ruta graveolens*, a native of southern Europe, but cultivated in England and the United States. Rue is a perennial plant two or three feet high, much branched, woody, on the main stem covered with a rough bark, but smooth and green upon the smaller branches. The leaves are fleshy, doubly pinnated, smooth, glaucous, and slightly tomentose. The flowers are of a pale greenish yellow, in terminal corymbose panicles, and are succeeded by four-lobed gibbous capsules containing numerous blackish angular seeds.

The plant exhales a strong aromatic but disagreeable odor, and has a bitter, hot, and acrid taste. Its active properties depend mainly upon a volatile oil of a greenish-yellow color, of a very offensive odor and acrid and bitter taste, which abounds in small glandular bodies covering the whole surface of the plant. By drying, a great part of its activity is lost.

HISTORY.—Hardly any medicine was more frequently employed or with greater confidence in its virtues than this now neglected plant. We think the reader will find in the summary which follows of medical opinions concerning its value, that it is at the present day too much disused.¹

It was among the medicines frequently recommended by Hippocrates. He says that it is rather diuretic than laxative, and, indeed, is somewhat astringent, and is good to take as a preservative against poisonous substances.² But it was chiefly used by him in uterine affections; when taken with wine to promote the lochial discharge; with astringents to moderate plethoric menorrhagia; with aromatic stimulants in amenorrhœa, &c.³ Dioscorides dwells at length upon its virtues; says that it is caustic, calefaciant, ulcerative, diuretic, emmenagogue, and astringent to the bowels. It restricts the secretion of semen, and with anise relieves colic; it allays pains in the chest, dyspnoea, cough, gout, and sciatica, and cures intermittent fever. Clysters of oil in which it has been boiled, are useful in flatulent colic. It is also anthelmintic, and eaten raw or applied in an ointment, it improves the sight; the bruised plant laid on the forehead arrests epistaxis; with

¹ The Greek name of rue was *πίργανον* from a verb signifying to constringe or coagulate, "quod siccitate et caliditate sua coagulet et condenset semen." It was also called *ῥύδιμεν* "quod libidinosos nimiumque veneri addictos frenet." (Bodæus, Theophrast. Comm., p. 797.)

² Du Régime, Littré's ed., vi. 559.

³ Ibid., viii., 105, 157, 245, 295, 449.

pepper, wine, and nitre, or with alum and honey, it cures various cutaneous eruptions and warts; and eaten after garlic or onions it prevents their tainting the breath. This author describes the wild and the cultivated varieties of rue, and dwells upon the acrid character of the former, saying that it has proved fatal when eaten in too large a quantity, and that those who gather it when in bloom are apt to have their hands inflamed, and pustulated by its contact, to prevent which the hands and face should be anointed before the plant is touched. Wild rue, he adds, is useful in epilepsy and sciatica, excites the menstrual flow, and destroys the foetus in utero.¹

Pliny, besides furnishing in detail the accounts given by his predecessors, and insisting upon the poisonous qualities of the wild plant, states that the juice of hemlock (*cicuta*) protects the hands of those who gather rue from inflammation, and that the juice of the latter, taken with wine internally, is an antidote to aconite, mistletoe, mushrooms, the bites of serpents and insects, &c. He also remarks that if, as Hippocrates supposed, rue is diuretic, it is singular that it should be used by some to moderate incontinence of urine.² Galen states, that when mixed with food it extinguishes the generative power by drying up the secretion of semen, and also that when strewed in the beds of those who are disposed to erotic dreams and priapism, it lessens the venereal excitement. Avicenna asserts that the seeds of rue increase the appetite, strengthen the digestion, and are useful in enlargement of the spleen. Rhazes says that it prevents flatulence from vegetable food, and relieves colic, but it is not good for persons subject to headache. Elgâfaki attributes this last effect, and dimness of vision, to excessive use of the plant, and alleges that in moderation it improves the eyesight. Another Arabian author states that the juice of rue rubbed upon the bald scalp will make the hair grow.³

The school of Salernum thus concisely enumerates the qualities of the plant:—

“Nobilis est ruta, quia lumina reddit acuta;
Auxilio rutæ, vir lippe, videbis acute;
Cruda comista recens, oculos caligine purgat.
Ruta viris minuit Vencrem, mulieribus addit.
Ruta facit castum, dat lumen, et ingerit astum.
Cocta et facit ruta de pulcibus loca tuta.”⁴

Schola Salernitana, xxxvii. 427.

¹ Mat. Med., iii. xlv.

² Hist. Mat. xx. li.

⁴ EBN BAITHAR, ed. cit., ii. 6.

⁴ So Macer Floridus celebrates the virtues of rue:—

“Utilis est valde stomacho si sæpe bibatur.
Expellit partus potu, veneremque coercit.
Tussim si bibitur compescit, menstrua purgat,” &c.

De Viribus Herbarum.

Murray in referring to the many virtues attributed to this plant by the ancients, suggests that the accounts of them require confirmation, yet he admits the strangest of them all, its power of curing epilepsy, to be well vouched for, and he claims for it a high value as an antihysterie medicine, particularly when there is at the same time suppression of the menses. Plenck attributes to a vinous infusion of rue applied as an injection, the cure of a caries of the nostrils and alveolar processes of the upper jaw; and Rosenstein, who saw the vapor of the plant cure a dimness of vision caused by excessive study, confirms the ancient statement given above.¹

ACTION.—It is remarkable that in several experiments performed by Orfila upon *dogs*, and in which the juice of the plant or its watery extract was introduced into the stomach, the animals perished without any decided symptoms, and the organs after death presented no local lesions capable of explaining the result. When the essential oil was injected into the jugular vein of a dog, symptoms of intoxication appeared, but they were only of a few hours' duration.²

Upon *man* rue acts *locally* as an irritant. This fact was well known to the ancients, as the citation from Dioscorides already given proves. The following is a case reported by Buchner. In June, 1823, after several very hot days, an apothecary named Roth gathered a quantity of garden rue, in full bloom, and stripped the leaves of it from the stalks. On the following morning he observed a considerable redness and heat of both hands, and the next day they had the appearance of having been exposed to the steam of hot water. They were then anointed with oil, but against the evening they were covered with vesicles, especially at the ends of the fingers which had been most in contact with the plant. On the fourth day the hands were still swollen, and between the blisters the skin was of a purplish hue. The fifth and sixth days the swelling extended up the back part of the arms as far as the elbows. Fomentations of chamomile and elder-flowers were applied, and the blisters cut. In the course of four weeks the entire cuticle exfoliated by degrees, even where there had been no blisters. His children, who had played with the rue, suffered from swelling of the face and hands.³

The effects of large doses of rue, taken *internally*, are described by M. Hélie in an article published in 1838,⁴ and this contains, so far as we know, the only account of the subject, except the case of a man convalescent from dysentery, who died with symptoms of intestinal inflammation after drinking some brandy mixed with the expressed

¹ Appar. Medicam, iii. 112.

² Toxicologie, 5ème éd., ii. 579.

³ WILMER, Wirkung, &c., iv. 427.

⁴ Bull. de Thérap., xv. 75.

juice of the herb.¹ M. Hélié relates three cases of attempts to produce abortion by this plant, in one of which a decoction of the fresh sliced root, in the second a decoction of the leaves, and in the third the expressed juice of the leaves was taken. The effects were, in one case, violent pain in the stomach, and vomiting, or rather efforts at vomiting, with the rejection of a small quantity of blood. In all of the cases the nervous system was prominently deranged; there were great prostration, confusion of the mind, cloudiness of vision, feebleness of the pulse, and coldness of the extremities, with twitching of the limbs. All of the females, who were in the fourth or fifth month of pregnancy, aborted and recovered. Dr. Christison remarks, concerning the narrative which has here been briefly given, that it may be suspected that M. Hélié overrated both the poisonous properties of the drug and its ability to induce miscarriage.² But, presuming the account, however imperfect, to be accurate, we are obliged to recognize in it a proof of the general sedative and locally irritant action of the medicine in large doses, and of its specific operation upon the uterus.

USES.—There can be little doubt that rue is an efficient *antispasmodic*. Ancient authorities attest it, and among the modern even Cullen has “no doubt in asserting its antispasmodic powers.” Haller also compared it to assafoetida, and administered enemata containing it to hysterical women. In *flatulent colic* the infusion of the herb, or, still better, a solution of the essential oil, answers the same purposes as peppermint and the stronger carminatives. But it is in *amenorrhœa*, independently of plethora or inflammation, that this substance becomes a powerful emmenagogue. It not only, like ergot, acts upon the gravid uterus, but it stimulates the unimpregnated organ also. Alibert particularly recommended it in *dysmenorrhœa*, and it is probable that, owing to its influence upon the nervous system, it is best adapted to those cases which are attended with hysterical symptoms. In Chili it is said to be applied to the umbilicus and to the soles of the feet to produce an emmenagogue effect. It has also been prescribed as a *vermifuge*.

ADMINISTRATION.—The great loss of power which this plant undergoes in the drying process renders the fresh herb or the oil preferable for obtaining its medicinal effects. The latter, therefore, is the only available preparation which the apothecary can supply. It may be prescribed in doses of from one to five drops, suspended in mucilage and some aromatic liquid, and repeated at intervals of three or four hours until some of its specific effects are manifest.

¹ G. F. COOPER, Med. Examiner, N. S., ix. 720.

² On Poisons, Am. ed., p. 682.

SALVIA.—SAGE.

DESCRIPTION.—Sage (*salvia*, from Lat. *salvare*), consists of the leaves of *Salvia officinalis*, a perennial plant which is a native of Southern Europe, but is cultivated as a kitchen-herb in our gardens. It is about two feet high, has a hollow, quadrangular, pubescent stem, ovate-lanceolate, wrinkled leaves, of a grayish-green color; sometimes tinged with red or purple. The flowers are bluish, and arranged in scanty whorls which form a terminal spike. These and the leaves have a strong and agreeable odor, and an aromatic, bitter, and somewhat astringent taste, which are due to a volatile oil. This oil, which is very abundant in the fresh herb, contains a large proportion of camphor. The plant also yields bitter extractive and tannin.

HISTORY.—The ancient reputation of sage is proved by the well-known lines of the school of Salernum—

“Cur moriatur homo, cui *salvia* crescit in hortis.”

and

“*Salvia* salvatrix naturæ conciliatrix;”

or by the still earlier verses of Macer Floridus,¹ in which it is said—

“Cum mulsa jecoris prodest potata querelis,
 Pellit abortivum, lotiumque et menstrua purgat . . .
 Crudis vulneribus (quæ multo sanguine manant)
 Apponas tritam, dicunt retinere cruorem . . .
 Pruritus vulvæ curat virgæque virilis,
 Si foveas vino fuerit quo *Salvia* cocta.
 Illius succo crines nigrescere dicunt,
 Si sint hoc uncti crebro sub sole calenti.”

But equally precious qualities had been attributed to sage for more than a thousand years before. In the Hippocratic writings it is called desiccant and astringent; it was prescribed for chronic pulmonary complaints in powder and infusion; for dysmenorrhœa and amenorrhœa, it was directed with or without wine, and also to promote the secretion of milk. Externally it was used in cataplasms and fomentations, and as a pessary in affections of the womb, or with wine to heal wounds and sores.² The account given by Dioscorides is a short one, and is paraphrased in the verses of Macer Floridus, quoted above. The plant described by Pliny is evidently not sage, although the virtues attributed to it are the same as mentioned by preceding writers. Matthioli quotes several ancient authorities which show how generally a belief was entertained in the emmenagogue properties

¹ De Viribus Herbarum, ed. Vossii, 1832, p. 64.

² DIERBACH, Die Arzneimittel des Hippokrates, p. 164.

of this herb, of its power to promote conception, and its usefulness in hæmoptysis.¹ Floyer pronounces it cephalic, diuretic, and diaphoretic, and says that it is cleansing in gargles, and in baths and ointments discutient.² In 1698, Hunauld, at Paris, and Stenzel, in Germany, undertook to show that sage might be profitably substituted for Chinese tea, as a drink,³ and it was even affirmed that the Chinese and Japanese preferred it.

ACTION AND USES.—Sage is stimulant, tonic, and astringent. M. Pidoux states that the infusion of half an ounce of the leaves which he took, cold, in the month of July, produced a copious sweat of several hours' duration, with insufferable flushes of heat, a slightly quickened and fuller and more active pulse, restlessness, which made study difficult, thirst, dryness of the mouth, an unusual state of constipation, a rapid increase of the appetite, and some degree of wakefulness.⁴

In regard to its curative virtues, Murray, who claims to be equally removed from scepticism and credulity in regard to the plant, admits it to be, like other aromatics, a nervine stimulant, a tonic and astringent, and adapted to dissipate and purify stagnant humors. One of its most valuable operations, undoubtedly, is that of checking profuse *perspiration* when it arises from debility, particularly, as Van Swieten observes, in the decline of protracted fevers. For this symptom Sydenham prescribed Malaga wine, but Van Swieten directed an infusion of sage in wine, and gave a wineglassful of it night and morning, or used brandy instead of wine, and, in that case, a smaller dose. He seldom or never found it to fail.⁵ According to the same authority, the like treatment is injurious in phthisis, for although it arrests the sweats, the heat and harshness of the skin are increased. Fr. Dubois says, however, and in this we are disposed to agree with him, that sage tea, taken cold, will often moderate the sweats of the last stage of phthisis. He adds that by its means he suspended sweats which came on nightly for ten months, in the case of an old man who was otherwise healthy, and in that of a female under like circumstances.⁶ Sage appears also to exercise some control over the secretion of *milk*, for Van Swieten found that, when, after the child had been weaned, and a troublesome dropping continued, the nurse growing leaner every day, and when he had tried various remedies in vain, the disorder ceased on his giving every three hours, one, two, or three ounces of a strong infusion of sage.⁷

¹ Commentaries, p. 273.

³ MURRAY, App. Med., ii. 199.

⁶ Commentaries (Edinb. 1776), vi. 289.

⁷ Op. cit., xiv. 234.

² Touchstone of Medicines (1687), p. 258.

⁴ Thérapentique, 5ème éd., ii. 482.

⁶ Mat. Med. Indigène, p. 140.

An infusion of sage as a mouth-wash for the cure of *aphthæ* affecting the buccal mucous membrane has long been in popular use;¹ it is applied with honey, and either with or without the addition of red wine.² The internal use of the infusion at the same time is of essential service in obstinate cases. It has also a very beneficial influence, when used as a gargle, in the treatment of *sore-throat*, especially of the ulcerative form, and also when the mucous membrane of the part remains loose and flabby after inflammation. It may be sweetened with honey if a merely detergent effect is required, or, if an astringent or stimulant operation is sought, it may be mixed with red wine or with alum, or acidulated with vinegar or aromatic sulphuric acid. M. Pidoux has found a simple decoction of sage, or a vinous decoction, with honey, a very efficient means of promoting the cicatrization of *indolent ulcers* of the legs, when it is applied to them by means of compresses. Sage is also one of the ingredients of the *vin aromatique* of the French Codex. It has been used in warm baths as a means of giving tone to the skin and to the system generally, and as a wash to be applied in *intertrigo*. The most common use of sage is culinary. It forms a principal ingredient of the seasoning used for gross and fatty meats, such as pork and goose.

ADMINISTRATION.—An *infusion* of sage made by macerating an ounce of the leaves in a pint of boiling water, may be prescribed in doses of two fluidounces. If it is intended as a drink in fevers or to allay nausea, the fresh herb is preferable, or an infusion of the dry herb without maceration. As a *gargle*, an infusion containing from one to two ounces to the pint may be directed, with the addition of honey, alum, vinegar, or a mineral acid.

SAMBUCUS.—ELDER FLOWERS.

DESCRIPTION.—These are the flowers of *Sambucus Canadensis*. In Europe *S. nigra* is the officinal plant, but the qualities of the two agree. American elder “grows in all parts of the United States, and is a shrub from six to ten feet high, with a branching stem, which is covered with a rough gray bark, and contains a large spongy pith.” The leaves are opposite, pinnate, or sometimes bipinnate, composed of opposite pairs of deep green leaflets. The flowers have a sweetish but heavy smell, are minute and arranged in large cream-colored or white corymbs, and are succeeded by small globular berries

¹ WEDEL in MURRAY, App. Med., ii. 202.

² ROSENSTEIN, Mal. des Enfants, p. 47.

which are purplish-black when ripe. Elder flowers yield by distillation a small quantity of essential oil, and of ammonia, and contain, besides, tannic acid, an acrid resin, and various minor constituents. The juice, which is purple and has a sweetish taste, contains malic and citric acids, sugar, &c. The inner bark possesses more active properties than the flowers. Its taste is at first sweet, but afterwards astringent, acrid and nauseous.

HISTORY.—The ancients made use chiefly of the root, leaves, and bark of the elder as purgatives and diuretics, and of the flowers as emollient and anodyne applications. Sir John Floyer says “the bark and seeds are great water purgers in the dropsy and gout. The juice of the root makes a good purging syrup; the leaves are used in diet-drink for the dropsy; and outwardly in fomentations and ointments for tumors, scalds, burns, gout, and ulcers.”

ACTION AND USES.—*Elder berries* are cooling, aperient, and diuretic, and when fermented, form an agreeable wine much used in England as a domestic cordial.

The *flowers* are stated to be poisonous to peacocks, and the berries to hens. A warm infusion of them is an excellent diaphoretic. Large doses of the *fresh* flowers are said to produce nausea and diarrhœa. Water distilled from them (elder-flower water), is used as a perfume; and they are boiled with lard to prepare an ointment much employed in Europe as a pleasant application to burns and excoriated surfaces. Elder flowers saturated with hot water are very much used, either alone or with chamomile flowers, as an application to parts affected with rheumatism, abscess, inflammatory swelling, or other local cause of pain. The young *leaf buds* are said to be a drastic cathartic. The *inner bark*, it has already been stated, was formerly employed for this operation. More recently Sydenham, Boerhaave, Gaubius, and Desbois de Rochefort, used it advantageously in many cases of dropsy. In 1831, Martin Solon published an account of five cases of ascites in which the juice of the elder-root effected a cure after the failure, in some of them, of other remedies. He prescribed it in doses of one or two ounces taken fasting. Soon after taking it a copious discharge of saliva and mucus from the mouth occurs, and within an hour a sense of fulness at the epigastrium is followed by vomiting without excessive straining. In the course of two hours a call to stool is announced by colic, and the dejections are serous, thin, pale, or a little tinged with bile. They continue for eight or ten hours, and the following day the stomach is not disordered, on the contrary, the appetite is increased. After repeated doses of the medicine, the secretion

of urine is augmented.¹ Other eases have been treated with equal success according to this method, by Hospital,² Bonnet,³ Bergé,⁴ Mallet,⁵ Reveillé-Parisc,⁶ and Faivre.⁷ It certainly deserves to be resorted to more frequently than it has been.

ADMINISTRATION.—The *expressed juice* of the fresh root is probably the most reliable of the medicines derived from elder; it may be given in doses of a wineglassful every two hours, or until its specific effects appear. A *decoction* of the inner bark may be prepared by boiling an ounce of it in two pints of water to a pint. Four fluid-ounces may be given at a dose.

Elder-flower water (AQUA SAMBUCI), and an ointment, above referred to (UNGUENTUM SAMBUCI), are officinal.

THYMUS.—THYME.

The flowering tops of garden thyme are seldom used, except for culinary purposes, but containing, as they do, a volatile oil, and having the agreeable aromatic odor of other herbs belonging to the class of aromatic stimulants, they may be substituted for sage, balm, or even mint, if necessary, in the treatment of colic, or to produce diaphoresis, or in fomentations or poultices to painful parts. By distillation, thyme furnishes a volatile oil, which is generally sold under the name of *oleum origani*, and employed for the same purposes as the true oil of *O. Marjorana*, or *O. vulgare*.

ZINGIBER.—GINGER.

DESCRIPTION.—Ginger is the rhizome of *Zingiber officinalis*, a native plant of China and India, and cultivated in Africa, South America, and the West Indies. It has an annual articulated stem two or three feet in height, inclosed in an imbricated sheath; long, narrow, lanceolate leaves; and a separate flower-stalk, terminating in an oval imbricated spike, between the scales of which one or two yellowish flowers appear. The root (rhizome) is tuberous, creeping, and articulated. It is in it that the virtues of the plant reside.

As found in commerce, the dried root is covered with a coarse blackish and wrinkled epidermis, but is whitish and farinaceous within, or is altogether of a light color in consequence of the epidermis having

¹ Bull. de Thérap., ii. 161.

² Ibid., iv. 159.

³ Ibid., v. 190.

⁴ Ibid., vii. 99.

⁵ Ibid., viii. 369.

⁶ Ibid., x. 116.

⁷ Ibid., xxiv. 231.

been removed. The former variety is chiefly derived from the East and the latter from the West Indies, and particularly from Jamaica. When powdered, it is of a light yellowish-brown color.

The odor of ginger is aromatic and pungent, and its taste is hot, biting, and aromatic. It yields its active properties to water, but more completely to alcohol. They depend upon an essential oil, and upon a soft acrid resin extracted by means of ether.

HISTORY.—It does not appear that ginger is mentioned by any writer earlier than Dioscorides. He states that it is a peculiar Arabian plant, that the roots taste like pepper, and are sold in pots as a preserve. He adds that it is good to eat and to use as a condiment; that it is warm and quickens digestion, is stomachic and slightly laxative; that it removes everything that obscures the sight; and, finally, that it resembles pepper in its action.¹ Paulus Ægineta mentions ginger-root as powerfully heating. Mesue, the younger, says that when preserved it improves the digestion, expels flatus, and hastens the assimilation of the food.² According to the Arabian writers it is also aphrodisiac, assists the digestion of melons and similar fruits, renders the action of purgative medicines milder, and a warm infusion of it prevents the effects of exposure to cold.³ The native doctors of India regard it as a valuable carminative and stimulant; they also recommend it as an external application, mixed with arrack, in paralytic and rheumatic affections, and employ it as an ingredient of the decoctions used for arresting the progress of intermittent fever.⁴ Piso gives a very correct although brief account of the virtues of ginger, saying that it is a most excellent remedy for colicky pains, for protracted diarrhoea arising from cold, for flatulence, and for intestinal tormina; but he adds that constant care should be taken by persons of an ardent temperament to use it sparingly, whether in sickness or in health, because it inflames the blood.⁵

ACTION AND USES.—Ginger is a carminative stimulant, exciting a sense of warmth in the stomach, and increasing its activity momentarily, but afterwards leaving it feeble. Its primary action is also to quicken the circulation, diffusing a genial warmth over the whole body, and, according to some, rendering the cerebral functions more active. When powdered ginger is applied in a moist state to the skin, it occasions redness, with a sensation of intense heat and tingling. Snuffed into the nostrils, it acts as a powerful sternutatory; and when the rhizome is chewed, it occasions a copious secretion of saliva.

¹ Mat. Med., ii. cliv.

² EBN BAITHAR, ed. Sontheimer, i. 537.

⁵ Mantissa Aromatica (1658), p. 189.

³ Opera, Apud Juntas (1581), p. 132.

⁴ AINSLIE, Mat. Ind., i. 152.

Ginger is most frequently employed as a stomachic stimulant in torpid states of the stomach with general debility of the system, but in such cases it is more advantageous when associated with stimulant tonics whose influence is less evanescent than its own; or, when an anæmic state of the system is also present, powdered ginger with precipitated carbonate of iron or with metallic iron may be given. It is also prescribed in connection with purgatives administered to persons of a feeble constitution, who are subject to colic, or who are of a gouty diathesis. As a carminative and anodyne in flatulent colic no remedy is superior to a hot infusion of ginger, and this preparation, or the tincture, is an excellent medicine during the hot summer season, when there is a strong tendency to diarrhœa. During the prevalence of Asiatic cholera this susceptibility of the digestive organs is often successfully corrected by the occasional use of a few drops of tincture of ginger in hot sweetened water. But care should be taken not to resort habitually to this expedient, for of all the stimulants of its class none exhausts the susceptibility of the stomach more rapidly. It is then apt to impair the appetite and digestion, and induce a dry or pasty condition of the mouth, with general languor. The infusion has been sometimes used with benefit in cases of bronchial catarrh, such as aged persons are subject to.

As a rubefacient, ginger is a most useful application. It is one of the ingredients of the aromatic powder so frequently used with hot brandy as an anodyne application to the abdomen in cases of colic. Alone, or with other substances of the same class, it is also applied to the face for the relief of toothache, to the temples or forehead in headache, &c. Its infusion is often resorted to as a gargle to correct relaxation of the uvula; and the rhizome may be used as a masticatory to stimulate the tongue and adjacent parts when they are affected with paralysis. This use of ginger, or that of the gargle, is often serviceable in cases of aphonia proceeding from relaxation of the vocal apparatus.

ADMINISTRATION.—The dose of *powdered* ginger is from ten to thirty grains; of the *infusion* (INFUSUM ZINGIBERIS), made with half an ounce of the bruised or powdered root to a pint of boiling water, one or two fluidounces; and of the *tincture* (TINCTURA ZINGIBERIS) from forty minims to a fluidrachm. The *syrup* (SYRUPUS ZINGIBERIS) is a convenient addition to mixtures, or a vehicle for powders, whose taste is disagreeable, or which, without this, might offend the stomach. It forms in this way an excellent means of administering magnesia and alkaline preparations. In many cases of nausea and vomiting for which gastric stimulants are appropriate, artificial carbonated water, flavored with ginger syrup, proves useful in settling the stomach.

CLASS V.

GENERAL STIMULANTS.

GENERAL Stimulants are agents, the primary action of which is temporarily to increase the vital activity of the whole system. Vital activity is recognized chiefly in phenomena which the circulation and the nervous organs present, and by the degree of their vigor, under the operation of general stimulants, we estimate the power of these medicines. Under their influence the heart and arteries pulsate more strongly, the capillaries become distended with red blood, the animal temperature is raised and all the functions, but those of the nervous system in particular, are rendered more active. Such stimulants may with propriety be denominated general, in contradistinction to such as excite particular organs or apparatus. They are also general, in opposition to those whose specific operation is confined almost altogether to the nervous system, whether to its cerebral portion chiefly, as in the case of narcotics, or to its spinal axis as in the case of spinal stimulants, or whether it affect both of these systems in various degrees in the manner of antispasmodics.

The only articles which have an unquestionable right to be included in the present class are heat, electricity, alcohol, and wine. No doubt can be entertained regarding the propriety of the title of general stimulants applied to the two latter articles, but it may be considered that the first two would be more correctly placed in the class of Irritants.

Heat and electricity applied in a concentrated form are unquestionably irritants; but, as it elsewhere is stated in regard to the moxa, there is a specific impression produced by them beyond that which depends upon irritation of the skin. The frequent association of moisture and heat in the therapeutic applications of the latter, both locally in fomentations, and generally in the form of baths, produces a stimulant effect which cannot be represented by the action of any mere irritant upon the skin. To these examples may be added the

union of light and heat, in the treatment of certain chronic diseases by insolation, the operation of which is altogether peculiar, and independent of any degree of irritation, unless a perfectly normal stimulation may be so called. Still more peculiar is the operation of electricity. A local irritant when concentrated, a special excitant of the spinal nerves in some of its forms of application, it is nevertheless a powerful general stimulant, and probably as essential an element of vital activity as caloric itself.

In regard to the remaining medicines to which, less from conviction than in compliance with custom, we have assigned a place in this class, viz., oil of turpentine, carbonate of ammonia, arnica, and poison oak, their claims to the position are very questionable indeed. The general stimulant operation of the first two, especially, is extremely transient, and is speedily replaced by local irritation, in the bowels and urinary passages in the case of the one, and by grave and important alterations of the blood in that of the other. The remaining two medicines, with serpentaria, appear to possess the qualities of stimulant diaphoretics rather than those of simple stimulants. The ensuing remarks on the general use of stimulants will therefore be considered as primarily having reference to the operation of alcoholic liquors alone, and to other agents only in so far as their stimulant element is involved. That element exists in some narcotics and in a larger number of antispasmodics, but in none of these medicines does it constitute the chief agent of their therapeutical power.

Stimulant (from *stimulus*, a spur or goad) is a term applied to all medicinal agents which directly increase vital activity, and as before stated, the epithet general is given to those stimulants which directly augment the vital activity of the whole economy. Food and oxygen are the essential stimuli of the living organism, the first supplying the means of the primary, and the last, those of the secondary digestion, and both together setting on foot those movements by which we recognize the presence of life, and without some degree of which it is difficult, if not impossible, to conceive that life exists. Hybernating animals and insects may give no moving evidence of vitality, yet we know that they consume the store of carbonaceous matter which instinct has taught them to provide for their long sleep. The grain of wheat which germinates under the warm rays of the sun, after reposing for thousands of years in the darkness of an Egyptian tomb, must have an aliment for the life that is in it, how incalculably small soever the store of it may be, and however sparing its consumption; for to believe otherwise, to suppose that the life of the seed is merely potential, and is substantively created by the access of light, heat, and

moisture, is opposed to all analogy and rational deduction. To the apparently dead seed these influences are the conditions of its development, they are the stimuli which arouse it from its state of suspended animation. Under the influence of the normal stimulants, food and oxygen, and of the caloric developed by their reactions, as well as by that derived from natural and artificial sources, the functions of the organism acquire a certain development and attain a certain degree of strength which are almost as various as individual men. Indeed their vigor is subject to perpetual mutations even in the same individual; by day, by night, at rest, in exercise, feasting or fasting, it is incessantly changing with the supply of nutritive material, the waste of the organs, and, perhaps, even independently of these to some extent, with the intensity and amount of nervous power determined by the nature and degree of the mind's action. Nevertheless, there is in the case of every individual a certain average condition which may be called his state of health, and in which the variations of vital power oscillate between known extremes.

In disease the susceptibility to natural stimuli is changed. In the greater number of cases it is augmented, and, indeed, is rarely diminished except when profound alterations have taken place in the nutritive function, or in the central organs of the nervous system. Of this fact illustrations will be offered in the sequel. It is more important, in this place, to observe that by a law of the human economy the repeated impressions of a stimulus produce progressively feebler results. There is scarcely any exception to this law. All our senses are, to use the common and expressive term, *blunted* by the repetition of the same impression upon them; every organ gradually becomes insensible to operations which at first may powerfully have excited it; even the affections lose their freshness and the passions their fire; there is, in fact, nothing but pure intelligence which appears permanently and almost without limit to have its powers and susceptibilities increased by exercise. Yet excessive action even of the mind exhausts the vigor of the brain for a season, or may entail the permanent hebetude of its faculties. Hence it is that not only stimuli which produce a local impression exclusively or chiefly, but those also which, like the subjects of the present chapter, are general and diffusible in their operation, tend by degrees to exhaust the susceptibility of the system to their influence. If a protracted administration of them becomes necessary, their doses must usually be increased, even in cases where they have not been used as habitual stimulants in health; but, where they have been so employed, and particularly when this has been done intemperately, larger quantities must be administered, not only

to produce a given degree of stimulation, but even for the purpose of sustaining the strength at a point consistent with the patient's safety. No fact is more familiar than that drunkards tend to sink under the attacks of all grave diseases, and especially under the action of causes which, like traumatic injuries, inflict a shock upon the nervous system. No matter what the local condition may be, how extensive soever the inflammation of the lungs, for instance, or severe the compound fracture, an essential condition of cure is the administration of alcoholic stimuli in at least the quantities habitually consumed by the patient. Without this precaution not only is there great danger that the strength will become speedily exhausted and life itself be sacrificed, but as a prelude to this result complete derangement of the nervous system may occur in the form of *delirium tremens*. Should this affection break out, its most efficient remedy is also an alcoholic stimulant. It is chiefly an exaggerated degree of that ataxia which every drunkard experiences when entirely free from the influence of his potations, the tremulousness of the hands, the uncertain gait, the wandering look, and the infirmity of purpose, to avoid which, and, in his own expressive phraseology, to "steady the nerves," he is obliged to employ another portion of the mischievous cordial to which he has sacrificed his independence.

This disorder of the nervous system, this *ataxia*, is met with in various diseases, and, in fact, constitutes one of the morbid states which may be superadded to almost any original affection. It presents itself constantly as an element of the nervous state, or diathesis, but it is then more appropriately treated by means of anti-spasmodics; because of the two elements which are usually conjoined in this state, excitability and weakness, the former is disproportionately greater than the latter. Not so, however, in the adynamic types of fever, which present loss of power as their primary and prevailing element, and ataxia chiefly as a secondary phenomenon. In such affections the influence of alcoholic stimulants is precisely of the same nature as in the state of depression, exhaustion, and nervousness which immediately succeeds the suspension of the drunkard's libations; they give tone to the system, and by doing so allay its nervous disorder. The greatest strength is everywhere associated with repose, and mobility is usually an indication of weakness. This is plainly illustrated by the contrasts which are presented by the male and the female sex, and by the robust and the feeble of either sex. In all cases whenever a cause, mental or material, stimulates the system strongly it produces an unwonted development of strength.

In adynamic diseases, or rather in the typhoid forms of disease, it

is probable that there is something more than a mere loss of strength, that there is an intoxication, a poisoning of the blood, and, perhaps, a vital metamorphosis in this fluid. And whether there be a poison to eliminate, or an organic revolution to be effected in the chemical or physical relations of the particles which compose the blood, time is essential for its accomplishment. Under the most favorable influences the process of cure must be slow and gradual, and whether its conduct have been mainly intrusted to nature, or whether evacuant remedies have been made use of in its early stages, the period arrives when, with more or less eluding of the faculties, feebleness pervades all of the organs, and especially those of animal life. Then it is that with due reference to the probable duration of the disease, alcoholic stimulants are indicated. Their management requires considerable tact, not only in regard to the period of commencing, and of discontinuing their use, but still more in relation to the size and the intervals of the doses which are prescribed. Nothing in fevers tends to exhaust the strength more rapidly than excessive quantities of alcoholic medicines. If their stimulation exceeds the normal bounds, if, in short, any degree of intoxication is produced, it must necessarily be followed by a proportionate degree of depression and exhaustion. The difficulty of preserving due moderation in this matter is enhanced by the altered susceptibility to alcoholic stimulants manifested in the diseases referred to. It really seems as if in some cases there were no other limit to the quantity of them which can be borne, than the capacity of the stomach to retain it; but, on the other hand, the limits of safety are usually much narrower than this. They are not easily determined except by experiment, which should always have in view the maximum amount that can be taken without producing morbid effects within a determinate period. The individual doses ought, on the other hand, to be relatively small; for by this means the stimulant action is maintained and the sedative operation avoided.

But the benefits of alcoholic medicines are not limited to their stimulant influence. They are food, according to the present chemical doctrines, in the sense that they restrict the waste of the body, and therefore indirectly sustain the strength. That is to say, they afford a large quantity of hydrogen with which the inspired oxygen combines instead of with the tissues themselves. It would, however, be very unwise to trust to them for the patient's entire support. On the contrary, the condition that calls for their employment is one that food is also adapted to cure, and hence it forms a necessary complement of the stimulant treatment of the typhoid state. It may, to some extent, be regarded as sustaining by its steadier strength the advances towards

cure made by the more active but interrupted efforts of alcoholic stimuli.

Apart from the typhoid types of disease in which diffusible stimulants display such precious qualities, there are two conditions in which they are also of signal utility. These are the forming stage and the decline of many affections. In the greater number of inflammations, as well as of some general diseases, the first sensible morbid act is a chill, one of the phenomena of which is the tendency of the blood inwards, and the congestion of internal organs. If this movement is slight, as it is apt to be when it is the forerunner of inflammations of moderate extent or degree, as in the case of coryza, tonsillitis, bronchitis, muscular rheumatism, &c., the stimulant operation of hot alcoholic drinks, particularly if seconded by external heat in the form of pediluvia, or the general warm bath, will frequently dissipate the gathering inflammation, and produce a resolution of the attack. But if the affection be one of considerable energy, such remedies may be inadequate to arrest its development, and, in that case, the reaction which necessarily succeeds the initial chill will be aggravated by the stimulants that have been administered. The fact appears difficult of explanation, but it is none the less established by experience, that whenever the state of disease is one of great depression, heat is of all stimuli the least efficient in overcoming it. In frost-bite, in the cold stage of algid intermittents, in the collapse of epidemic cholera, cold applications intense in degree, and exceedingly brief in their contact, constitute far more efficient remedies than any degree of heat above the average temperature of the body. Under the circumstances, these agents appear to act very much as the hot bath and alcoholic liquors do when no abnormal coldness exists.

The only other condition it is proposed to mention, for which diffusible stimulants are important remedies, is that of pure exhaustion. Exhaustion may be produced by powerful impressions made upon the nervous system, by sudden shock, which has already been referred to, or by prolonged fatigue. In the latter case, it is a matter of daily experience that these agents dissipate the sense of weariness and brace the system for renewed exertion. It is equally well known, although too little regarded, that an habitual resort to such stimulants robs them of their original utility, and is apt to induce habits of intemperance in their use. In many diseases, however, of chronic course, or attended with wasting discharges, or during convalescence from acute affections which have wasted the flesh and strength, these remedies are often in the highest degree serviceable, and often, indeed, appear to be essential to the cure. Not that they are directly curative. The

organs are usually in a state of atony, or apathy, if the expression may be allowed, which appears to be the direct effect of a diminished supply of blood. The composition of this fluid is probably altered by the loss of a portion of its globulin, but its quantity is evidently reduced if we but examine the pallid skin, and the thin, pale veins with which it is marbled. The stomach and intestines participating in the general debility, their secretions are scanty and of feeble power, the food which is eaten is not consumed, is not assimilated, and, above all, is eaten without appetite or relish. Bitter tonics, as it is elsewhere stated, tend to remove this condition, but they are seldom sufficient, if for no other reason than because their action is chiefly local. Alcoholic stimulants, on the other hand, are absorbed, and everywhere throughout the system arouse the dormant powers, excite a craving for food, quicken its digestion, promote its assimilation, and thus become purveyors to the nutrition of all the organs. These effects, which are directly curative in acute diseases, are the means of prolonging life, and of rendering it tolerable, in chronic affections for the ultimate cure of which time and the protracted use of appropriate remedies are necessary, or in which the inevitable termination in death can only be postponed. Such a one is tuberculous consumption of the lungs, the most common by far of all the ordinary causes of death. In that disease, alcoholic stimulants appear to form a natural harmony with fatty nutriment and muscular exercise, the only means which have yet been discovered either for its essential mitigation or its cure.

CALOR.—HEAT.

The term heat is used as a synonyme of *caloric*, and is also applied to the sensation which caloric produces. Thus it stands both for cause and effect. Nor is this double application of the term attended with inconvenience in ordinary language, for we know nothing of caloric except through the phenomena of heat.

It is probable that caloric exists in combination with all matter. Experimentally, heat is developed under a great variety of circumstances. Its most abundant source is the sun, which, by the concentration of its rays, manifests a prodigious calorific power. It is developed also by friction, percussion, and other modes of producing rapid molecular movements in bodies. All changes of matter from a rarer to a denser condition are accompanied by a disengagement of heat—as when a gas or vapor is condensed into a liquid, and this again into the solid form.

All organic actions involve more or less of such a series of changes, and therefore become sources of heat; and on this account, partly, all living organisms are, within certain limits, enabled to maintain a temperature above that in which they ordinarily exist, and thus to resist the destructive action of cold. Independently of a change of density, many chemical molecular changes evolve heat; and if combustion be included among such changes, they may be said to comprise the principal sources of heat. Electricity, also, whether it be developed by friction, or by chemical action, or, in a less degree, by magnetic induction, is also to be ranked among the conditions which develop heat.

Heat is the universal stimulant of the animal and vegetable organism, and is everywhere found in close relation to life. Indeed, in all ages, flame, the representative of heat, has been the chosen emblem of life. Like all other stimulants, it is no less destructive in excess than it is favorable to vital action when restrained within due limits.

In studying the influence of heat upon the animal economy, we must remember that it varies with the conditions under which it operates, and particularly with the degree of humidity to which the body is at the same time subjected. Hence, in order to simplify the subject as much as possible, we shall first of all consider the action of dry heat, then of heat combined with watery vapor, and finally of water itself, at and above the temperature of the body.

Of Dry Heat.

Under this head we shall consider the mode of action and the phenomena of radiated solar and artificial heat, of hot dry air, and of heated solids.

All of the animal functions are performed most perfectly when the body is at its normal temperature. If this latter is depressed, so also is the activity of the functions; on the other hand, if it is carried beyond a certain limit, the operations of the economy are equally embarrassed; and if raised to the highest point, it arrests these latter by deranging the animal mechanism, and ultimately by destroying its structure.

Within the range of temperature compatible with health the action of heat upon the tissues is to produce their expansion and relaxation; the bloodvessels are enlarged, the contour of the body becomes more rounded, and the skin softer and more pliant. At the same time the nervous energy is depressed, and muscular contraction becomes less vigorous.

If the heat is much above the average and customary degree, it

develops in the whole system a great susceptibility to external impressions. Friction is more apt to produce excoriation of the skin, and blisters draw more speedily; all the reflex actions of the economy and the muscular irritability are more easily excited. Humboldt found that a frog's heart, that had for twenty minutes been removed from its connections and ceased to beat, and which was but feebly excited by galvanic stimulus, lost its contractility entirely when placed in water at 50° F., but began anew to pulsate when it was immersed in water at 127° F.

Warm air promotes the secretions, and the perspiration in particular, and that in proportion to the warmth and dryness of the air. Yet the increase of the perspiration is not as visible as when the air is warm and moist; on the contrary, the secretion of the skin is absorbed by the air and removed as rapidly as it forms. If, however, the temperature is very high, it excites the skin to the secretion of liquid more rapidly than it can be removed by evaporation. In either case, however, the evaporation produces cold, and thereby reduces the temperature of the skin, and renders the body capable of enduring a higher degree of heat than could otherwise be borne. To this protective power a limit is imposed by the amount of moisture contained in the body; and hence if the air be extremely dry and hot, and its action greatly prolonged, it robs the organs of the moisture essential to their free play, and becomes a cause of suffering and disease.

When the action of heat of a high grade is limited to a small portion of the body, a sensation of warmth and burning is excited, the bloodvessels are congested, the cutis swells, and erythema or vesication ensues, followed by desquamation. A still higher temperature produces, in addition, subcutaneous effusion and superficial gangrene; and a degree of heat yet more extreme decomposes and carbonizes the tissues to which it is applied.

When heat of a moderate degree acts upon the organism reduced by sickness below the normal temperature, it becomes a quickening and a strengthening agent. This is strikingly shown during convalescence, when there is a marked susceptibility to cold, but when also the feelings and strength revive under the genial influence of a sunny day, or of a cheerful fire. In like manner the development of disease may sometimes be arrested by counteracting the depression and coldness which usher in the attack.

Insolation.—Solar and artificial heat combined with light are transmitted differently by different bodies. The sun's rays penetrate the atmosphere and all colorless gases without warming them. White bodies reflect nearly all the calorific as well as luminous rays, while

black substances absorb them nearly all. Hence, in popular parlance, dark-colored clothing is warmer than light-colored.

When the sun's rays are moderately warm, they excite in the skin and throughout the body a quickening sensation, particularly if, as already remarked, the temperature of the body have been previously lowered by sickness. If the sun's heat increases, it may cause the skin to be reddened, swollen, and painful, and even blistered, the cuticle generally desquamating in consequence. If the head is directly exposed to the heat of the sun, the result may be sunstroke, an affection which is often fatal, and in which there is generally insensibility, sometimes convulsions, and sometimes apoplexy.

The temperature in the sunshine which shall be suitable in a given case of disease, can hardly be determined beforehand; it depends mainly on the sensibility of the patient. In general, a place should be selected which is perfectly dry, open towards the south, and shielded from the northern winds, so that the patient shall enjoy the reflected as well as the direct rays of the sun. At the same time his head should be protected from their action, and the feet kept warm and dry.

Warm and dry Air.—Dry is a relative, and not an absolute term as applied to air in its present connections. Air is said to be dry when it contains but little moisture in proportion to its temperature. The drier and warmer it is, the greater also is its capacity for moisture. Thus, at the medium state of the barometer, 760 parts of atmospheric air, when they have been long in contact with water,

at -4° F.	contain	1.33	parts of watery vapor ¹
$+13^{\circ}$ F.	"	2.63	"
32° F.	"	5.06	"
50° F.	"	9.48	"
68° F.	"	17.41	"
86° F.	"	30.64	"
122° F.	"	88.74	"
194° F.	"	525.28	"

Hence the drier the atmosphere, the more abundant must the exhalation of moisture be from the lungs and skin.

The general action of warm dry air upon the economy resembles that of radiated heat. At temperatures compatible with the free performance of its functions, the body shows the results of a stimulant influence, and especially in a great increase of the perspiration. The evaporation of this liquid absorbs so large a portion of caloric, that the normal temperature of the skin is little, if at all, exceeded.

¹ MITSCHERLICH, op. cit., ii. 392.

When, says Rapou,¹ the body is inclosed in an appropriate apparatus heated to 122° F., the heat is at first hardly perceptible, but by degrees the skin grows warm, the face is somewhat flushed, and the pulse rather fuller and more frequent. After a while a gentle moisture breaks out. At 131° F. the heat is rather annoying, but yet tolerable; it makes itself felt with smarting pain wherever there is a scratch, or pimple; the general and capillary circulations are quickened; the skin grows red, and it, as well as the subcutaneous cellular tissue, is swollen by the afflux of blood; the pulse is fuller and somewhat more frequent; the face is injected, and perspiration breaks out. This latter becomes more abundant after the bath, if the patient is warmly covered in bed, and uses warm drinks.

The first sensation experienced on entering a hot air bath at 150° to 160° F., is a sort of constriction of the integument; sometimes there follows a smarting and annoying pruritus over the whole body, but more particularly upon the upper part of the breast, around the umbilicus, and on the scrotum; the latter contracts firmly. The pulse is at first small and hurried, and the respiration is sometimes embarrassed; the head seems as if it were compressed by a tight band. These primary phenomena are succeeded by a sort of reaction; the skin is burning hot, the pulse is frequent and full, the temporal arteries throb, and sometimes the veins of the forehead are somewhat swollen. A copious sweat breaks out, particularly upon the head; the mouth is sometimes dry, and the thirst urgent. A slight heaviness of the head is experienced, which, like the perspiration, continues for some hours after the bath. This latter should not be prolonged beyond twenty-five or thirty minutes.

If the lower half only of the body is inclosed in the hot-air box, the perspiration breaks out simultaneously on all parts of the skin, and even more promptly upon those which are not directly exposed to the heat, provided that they are well protected from the air. In this manner there need be no fear of any unpleasant effects upon the head. Such baths are preferable for persons of a sanguine or irritable temperament, and when it is desirable to limit the action to the lower part of the body.

Dry and warm air acts upon the lungs as well as upon the skin. This is felt in a peculiar manner in dwelling-houses, warmed by hot air furnaces. If an apartment is heated to 65° or 68° F., a person in good health, and in ordinary clothing, feels comfortable, and experi-

¹ *Traité de la méthode fumigatoire*, p. 65, quoted in Trousseau and Pidoux, 5th ed. ii. 549.

ences no immediate inconvenience. But the atmosphere contains a much smaller proportion of vapor than if the air were warmed to the same degree by a stove or open fireplace. In this manner a great demand is made upon the system to supply the air with moisture, the skin and pulmonary mucous membrane are dried, and a condition is induced which cannot but be prejudicial to health.

It is to be remarked that when the atmosphere in which we dwell continues for some time at a high temperature, the perspiration is increased, the urine becomes scantier and more concentrated, and the alvine evacuations drier and less frequent. The thirst, also, is more urgent, and the appetite fails. These effects are constantly observed during the prolonged heats of summer. Then, and in hot climates generally, the secretion of bile augments, and bilious and hepatic diseases, with gastric derangement, diarrhoeas, and dysenteries, prevail. At the same time muscular strength declines, and there is a general inactivity of all the faculties, both mental and bodily.

When we are surrounded with and breathe air at a temperature of 100° to 120° F., besides experiencing the symptoms already ascribed to the hot-air bath, the respiratory passages become dry, the breathing is more hurried than usual and also more laborious. After a time restlessness and oppression, weariness, mental lassitude, and fulness of the head are experienced. If the clothing is thick so as to prevent cooling by exhalation, the symptoms are still more marked, and the greatest relief is obtained by exposing the skin completely to the air. As will presently be seen, when the heat is more intense, the clothing serves to protect the body from its operation.

At still more elevated temperatures the symptoms described become more decided, and assume a threatening aspect, yet such degrees of heat may still for a short time be sustained. Tillet speaks of a baker's girl who remained fourteen minutes, without injury, in an oven at 246° F. Berger supported a temperature of 229° F., for seven minutes. Fordyce, Bladgen, and several others remained for seven minutes in dry air at 150° to 212° F. They found that their presence lowered the temperature of the surrounding air, and in comparison with it their breath felt cool. The heat was disagreeable particularly upon the face and legs, the pulse rose from 92 to 100, the respiration was not oppressed, and the temperature of the skin in the axilla and under the tongue was 98° F. The perspiration was not always sensible owing chiefly to its evaporation, but the experimenters concluded that their clothing prevented the access of the hot air to the skin. Bladgen remained for eight minutes in dry air at a temperature of 240° to 260° F., and experienced a disagreeable but not an absolutely

painful sense of heat, and only a moderate degree of perspiration. After the seventh minute the breathing was laborious and painful, and the pulse rose to 144, but no permanent inconvenience ensued. Without clothing, this experimenter felt a more decided sense of heat, but at the expiration of twelve minutes, the sense of præcordial oppression subsided, owing, probably, to the outbreak of a profuse perspiration which completely exhausted him. In Dobson's experiments a young man remained for twenty minutes without great inconvenience in an oven, the air in which was at 210° F., but his pulse beat 164 in a minute.

Uses of dry Heat.—Several diseases are benefited by the judicious application of dry heat both natural and artificial. One of these is *rheumatism*. The sensitiveness of rheumatic patients to cold is a clear indication for the use of warm air in their treatment, at least in the subacute and chronic forms of the disease. Appropriate clothing, a dry and well warmed chamber, or a winter's residence in a southern climate is essential to the cure of the disease in many cases. Sometimes the hot-air bath, by provoking copious perspiration, has appeared to promote a cure; but in this respect it is inferior to the vapor bath. The influence of a mild climate in retarding or arresting the development of *tubercular consumption* is well known, and its efficacy, in spite of all apparent contradictions, continues to be attested by constantly recurring examples. Not only is it proved by those tuberculous patients who have had life indefinitely prolonged, by spending every winter in a warm climate, but by many others who have been equally fortunate in consequence of passing the cold season in apartments carefully warmed and ventilated and exposed to the southern sun. The prevalence of *scrofula* in low, damp, and ill-ventilated localities has led to its treatment by fresh, dry and warm air, and with a certain degree of success. But the influence of such air is more plainly seen in the exemption of places where it is enjoyed from *scrofula*.

Various methods are employed in the application of dry heat. *Linen, cotton, or woollen cloths*, heated in a stove, or at an open fireplace or furnace flue, are constantly used as local applications to the abdomen in colic, to the face in toothache, to the feet or to the whole body when a chill is threatening. *Hot sand, ashes, or clay*, contained in bags, hot bricks wrapped in woollen cloths, *tin cases* or *bottles* containing hot water, and applied to various parts of the body, are sometimes used in the cold stage of fevers, of cholera, &c.; in rheumatism, paralysis, and gout; and in restoring asphyxiated persons to life. Dr. Arnott has suggested an apparatus for the application of heat, which consists of a gum-elastic bag furnished with stopcocks, and connected

on the one side with a reservoir of water warmed by a spirit-lamp, and on the other with a waste-pipe. This bladder or bag can be laid upon the abdomen, or other affected part.¹

M. Guyot, observing that in hot, dry countries—as in Egypt, according to the report of Larrey—all wounds heal with marvellous rapidity, performed numerous experiments upon animals, inflicting wounds upon them, and then exposing them to the constant and regular action of heat. He found that his results corroborated the statements which have been referred to. He had also an opportunity of studying the influence of dry air upon the cicatrization of wounds in the case of patients who had undergone surgical operations at the Hôtel Dieu in Paris. His most important conclusions are that wounds without any dressing heal more rapidly in air at a temperature of 86° F. than at a lower temperature with or without dressing. In the experiments referred to, healing took place without inflammation or suppuration. In dry air, at the temperature mentioned, ulcers were found to heal with great rapidity.²

In the forms of dry heat still to be noticed, the temperature is so high as to produce disorganization of the skin; they are therefore local and very restricted in their direct action. They are stimulant in virtue of the pain they excite, revulsive and counter-irritant by means of the local fluxionary movement they occasion. The first and most potent is the *actual cautery*.

The actual cautery consists in applying to portions of the integument iron bodies, of various shapes and sizes, at a white heat. Its operation depends upon whether it is brought into actual contact with the tissues or only near to them, and also upon the duration of the action. If the heated iron approaches without touching the integument, it produces vesication or inflammation; if it is moved lightly and rapidly upon a part, it destroys the tissue superficially; if applied without motion, it destroys completely and rapidly the whole thickness of the integument, and even the parts beneath it. This application causes severe but not protracted pain, and is followed by general excitement or fever. The parts destroyed by the cautery gradually separate from the surrounding sound tissues, leaving an open suppurating sore.

The heated iron is employed to *destroy diseased structures*, to arrest *hemorrhage*, and sometimes as a *revulsive*. *Poisoned wounds*, as those

¹ Lancet, June, 1842, p. 439.

² Archives Gén., 2ème sér., viii. 273; 3ème sér., ix. 368; Traité de L'Incubation, par Jules Guyot, Paris, 1840; and Examen critique de L'Incubation, par E. Baudot, Paris, 1858.

of serpents and mad dogs, are sometimes treated in this manner;¹ but the caustic alkali is preferable, because it penetrates more thoroughly into the depths of the wound, while it is equally effectual in destroying the virus. *Fungous excrescences, gangrenous ulcers, carbuncles, varicose tumors, &c.*, are sometimes cured by the actual cautery; but in the case of the last-named affection the galvanic cautery is preferable. The hot iron is also used to promote the healing of *fistulous ulcers*, and those covered with flabby granulations, or which discharge an ichorous fluid. It is, moreover, sometimes preferable to any other mode of *arresting hemorrhage* in cases where ligature of the bleeding vessel is impracticable and compression unavailing. It coagulates the blood in the vessel, and forms, externally to it, a crust, which still further controls the bleeding. Larrey advised the actual cautery to be applied to the wound in cases of *traumatic tetanus*. Rémy reports a case in which spasms supervened on the ninth day after the receipt of a wound of the temple, and which was cured by cauterizing the cicatrix, in its whole extent, with an iron brought to a white heat.² Cotugno employed it in *sciatica* and *crural neuralgia*, by cauterizing the skin over the sciatic nerve between the tuberosity of the ischium and the great trochanter, over the origin of the peroneal nerve, &c.

Mayor's hammer acts in a manner similar to the above. A hammer is plunged into boiling water until its temperature equals that of the water itself, and then is applied to the skin. It occasions acute pain, and an eschar is produced. At a temperature of 176° F. it still forms an eschar, and at 158° F. it gives rise to a phlycten, and destroys at the same time a superficial layer of the cutis. Even at 150° the same result is produced if the iron is held for some time in contact with the skin. At 140° the pain is still almost intolerable, and vesication ensues. At 130° there is permanent rubefaction; and at 120° the rubefaction continues only for about an hour.³ Hot coals have been recommended as a cautery by Faure, and also by Lepeyre and Lecomte, who employed burning glasses to stimulate indolent and foul ulcers, certain cutaneous eruptions, &c.⁴

The *moxa* is a form of cautery which consists essentially of a small cylinder of cotton, or other vegetable fibre, which, by its combustion upon the skin, produces vesication or an eschar. The substances employed in making it have been various; such as the down of various species of artemisia; the agaric of the oak; the pith of the reed, or of the sunflower; flax, and also hemp, impregnated with some com-

¹ BONNET, Bull. de Thérap., liv. 184.

² Lond. Med. Gaz., Sept. 1849, p. 555.

³ TROUSSEAU and PIDOUX, op. cit., ii. 556.

⁴ MERAT and DE LENS, Dict. de Thérap., vi. 661.

bustible material; dried moss or wood; a roll of fine linen saturated with chlorate of potassa, &c. It is said to have been long employed by Oriental nations, particularly the Japanese and Chinese, from whom it was introduced into Europe by the Portuguese; but it was also used by the Egyptians, the Persians, and the Laplanders.¹

According to Larrey, the moxa cylinder should be about an inch long, and from a quarter to half an inch in diameter. One end of it is applied to the skin, and held in its place by a pair of forceps, or a *porte-moxa*, while the opposite end is lighted, and the surrounding skin protected by a damp rag, or by a piece of sticking plaster, or a piece of paper saturated with alum and dried, having an aperture in its centre. Combustion is maintained in activity by the breath, or by a pair of bellows, until the whole of the cylinder is consumed. To prevent deep inflammation and profuse suppuration, liquor ammoniæ should be immediately afterwards applied.² In some cases it is preferred to move the cylinder about within a small area, without allowing any one spot to be deeply involved; or again, to hold it very near but without touching the skin; or finally to remove it when the fire is at the distance of a line or two from the skin. Mr. Boyle used the moxa without bringing it into contact with the skin at all, but lighting the cylinder at *both* ends applied it within an inch and a half of the part, or less, so as to cause a slight degree of pain.³ The moxa should not be applied where the skin is the only covering of the bone, tendon, ligament, or cartilage, nor to the mammæ, genital organs, or abdomen. During its application, the first degree of heat causes the patient an agreeable rather than a painful sensation. This is gradually increased until the pain becomes tolerably severe. Mr. Wallace says: "I have had innumerable opportunities of ascertaining the opinions of patients respecting the comparative pain produced by moxa, caustic issues, and blisters, and I have never met with a single instance in which the moxa, when properly applied, has not been considered the mildest remedy by many degrees."⁴ Kæmpfer, in his history of Japan, quoted by the last named author, says, "the pain is not very considerable, and falls very far short of that which is occasioned by other caustics, or actual cauteries;" and Sir W. Temple, who has written an essay on its use in the cure of gout, declares that the pain ceases as soon as the fire is out.⁵

¹ AINSLIE, *Materia Indica*, i. 482; ii. 195.

² LARREY'S *Surgical Essays*, by REVERE, p. 21.

³ *A Treatise on Moxa, &c.*, Lond. 1825, p. 96.

⁴ *A Physiological Enquiry Respecting the Action of Moxa* (Dublin, 1827), p. 13.

⁵ *Works*, iii. 252.

In regard to the *modus operandi* of moxa, those who have most employed the remedy consider that it differs in action from the hot iron. Larrey supposed that it communicates to the surrounding parts, not only heat, but a very active and volatile principle which substances like cotton furnish while they are burning, and that the excitation and irritation resulting from these two causes extend gradually from the superficial to the deeper tissues. Boyle and Wallace also supposed that its utility is quite independent of any local inflammation, or any serous or purulent discharge, and indeed that it acts most beneficially when it produces the least disorganization of the cutis.

The *remedial uses* of moxa are the same as those of counter-irritant agents in general. It seems to have been peculiarly effectual in the following diseases: In affections of the *superficial joints*, as the knee and wrist, particularly in stiffness resulting from rheumatism; in *white swelling*, and also in *coxalgia*; in *diseases of the vertebræ* and their ligaments, and in lumbar abscess; in *neuralgia* and *sciatica*; in *lumbago*, *rheumatic gout*, and *paralysis*; and, finally, in *chronic bronchitis*.

Of Heat combined with Watery Vapor.

The temperature of the body may be elevated by the reception of external heat, or be lowered by the loss of its own caloric. This loss will depend upon the conducting power of the clothing worn, but also in a great degree upon the amount of moisture in the atmosphere. When the latter is in excess, and the temperature high, evaporation, which is a cooling process, is diminished, and the temperature of the body is raised; and if the air is saturated with moisture, the elasticity of the skin is impaired, and its exhalation suspended. But if the atmospheric moisture have a temperature much below that of the body, it abstracts heat from the latter with great rapidity, both by the cutaneous surface and the lungs, while it impedes or prevents the elimination of effete materials by these outlets.

Undoubtedly a certain degree of atmospheric heat and humidity is most conducive to health, but it probably varies for different persons, and cannot be scientifically determined. It is quite certain, however, that a moist and hot atmosphere, when long in action, exerts an injurious influence on the health. A very humid air at 65° to 70° F. occasions, in many persons, a sense of discomfort, and in proportion as both heat and moisture increase above this point, the sense of suffering becomes more general and distinct. The perspiration can no longer evaporate, but saturates the clothing and soddens the skin. At a temperature of 75° F., the intestine and kidneys secrete more fluid than usual, and

hence diarrhoea is a very frequent occurrence during prolonged heats. At a still higher temperature, however, as of 80° to 90° F., the atmospheric moisture does not prevent a profuse flow of perspiration, while the urine grows scanty and the fæces dry. The appetite for solid food fails, but acidulated liquids and subacid fruits are grateful to the taste. The temperature of the skin is slightly raised, the pulse is soft, but fuller and more frequent, and the veins are prominent. The nervous energy is impaired, the muscles are weak, the fat wastes away, and there is an irresistible inclination to rest and quietness, which any call to exertion, whether of mind or body, painfully disturbs. If this state is long continued, it becomes so far a morbid one that disease is developed in it by very trifling causes. Such is the case in the United States during the "dog days." Diseases of the digestive organs prevail, and often assume characters which denote a radical vitiation of the blood. The degree in which the phenomena which have been described occur, depends, in some measure, upon the nature of the clothing. When it is thin, permeable, and made of a good conductor of heat, it permits the evaporation of moisture, and, in so far, promotes bodily comfort, particularly if a current of air passes through it. When the temperature of air saturated with moisture exceeds that of the body, this latter, being relatively cold, precipitates vapor upon its surface which mingles with the product of its own exhalation, and no evaporation takes place from the skin. This latter feels hot, and becomes injected and swollen; by degrees the heat appears to penetrate to the internal organs, and the lungs probably contain more blood than usual. The pulse becomes more frequent. Fordyce found that it beat 145 after twenty minutes passed in a vapor bath at 120° F. At a still higher temperature the pulse becomes smaller and more frequent, an anxious sense of oppression at the præcordia is experienced, and congestion of the lungs, and, if these organs are diseased, hæmoptysis may ensue. There is also great weariness, with headache, vertigo, syncope, and even apoplexy, in consequence of cerebral congestion resulting from an engorged condition of the right side of the heart. The highest temperature, under the conditions named, which can be borne by a healthy man without serious injury, is still undetermined; but it is certain that a moist atmosphere of 165° to 170° F. can be endured without injury for a very short time only. The rise of the temperature of the body is not exactly in proportion to that of the air and vapor which surround it. Thus, Wiegand found that in a vapor-bath at 106° F., a thermometer placed in the mouth rose from 99° to 102° within five minutes, reached 104° when the bath was at 110° , and only gained one degree more when the temperature of

the bath rose to 117° . In another experiment, the bath being at 115° , the thermometer in the mouth rose from 98° to 104° within ten minutes, and yet marked only 107° when the bath was at 140° F. Even this degree of change in the thermometer may, perhaps, not be wholly due to an increased temperature of the body, but rather to the warm vapor drawn into the mouth through the nose; for when, under conditions otherwise the same, the thermometer is placed in the axilla, it does not indicate so great a degree of change.

As moist hot air becomes condensed into water when it comes into contact with the cooler surface of the body, it gives up more caloric, or heats the body more than dry air; and as the evaporation of water from the skin and lung almost ceases in a moist atmosphere at 99° F., it follows that heat combined with moisture becomes more speedily insupportable than dry heat. Indeed, direct experiment has shown that one may remain for *seven* minutes in dry air at 210° F., and that the temperature of the body will not rise more than one degree. Although a warm moist atmosphere restrains or even arrests cutaneous evaporation, there is, nevertheless, a sensible loss of weight, particularly at high temperatures, in consequence of the profuse perspiration which breaks out, and which, for remedial purposes, is promoted and prolonged by enveloping the body in warm blankets. The urine, meanwhile, becomes scantier, darker, and of a higher specific gravity. If the action of the skin is not maintained, but on the contrary is suddenly lowered, or arrested by the operation of cold, the result may be an attack of rheumatism or inflammation of some internal organ.

Modes of using warm, moist Air.—Warm, moist air and watery vapor above 96° F. are applied to the skin and lungs in general baths, or to the skin alone or to limited portions of it or of the mucous membrane. The vapor-bath on a large scale, and properly constructed, consists of a bathing-chamber and anterooms. The bathing-chamber is lined with wood and surrounded by several rows of benches rising one above another, so that on the topmost one the vapor is hottest, and on the others, successively less so. The steam is generated in Eastern countries by pouring water upon heated stones, but elsewhere in an ordinary boiler, whence it diffuses itself through the chamber. The temperature of the air varies with the elevation of the benches; on the lowest it does not exceed 96° F., but on the upper it reaches 160° F. A higher temperature is seldom used on account of the risk attending it. The anterooms, of which there are several, vary in temperature from 65° to 95° F. The bather undresses himself in a room at the lower of these temperatures, and puts on a loose bathing-gown, which, however, he lays aside in an adjoining apartment where the temperature is be-

tween 90° and 95° F. He then enters the vapor-bath, placing himself first upon the lowest bench, and gradually reaching the highest. At first, it is advised that this process should not occupy more than fifteen minutes, but after repeated baths it may be prolonged to half an hour or more. After bathing, the patient enters an adjoining apartment, and, partaking of some light, warm drink, remains until gradually he becomes cool; or else, if his object is to provoke a copious diaphoresis, he is wrapped in blankets upon a couch until this process is completed.

The *Russian vapor-bath*, so called, differs from the preceding by the addition of friction, shampooing, flagellation with birch rods softened by soaking in hot water, and affusion with lukewarm, cold, and even ice-cold water. In Russia it is employed as a hygienic even more than as a medicinal agent. Friction is made with flannel cloths well soaped and dipped in hot water, or with a hempen mop and soapsuds, or, if the patient be feeble, with bran and soapsuds. By these various expedients the skin is not only cleansed, but so strongly excited, also, that it burns, and smarts, and glows, and thus a powerful revulsive action from internal organs is established, which is found to be advantageous in many diseases. The affusion with cold water, at different temperatures, is sometimes repeated several times, and has the effect of cooling the skin, and promoting the perspiration, while so powerful is the tendency of blood to the surface that there is little danger of taking cold or of any internal congestions forming. But the contact of the cold must be abrupt and very brief if these dangers are to be avoided. Indeed, the excessive stimulation of the skin which characterizes the Russian bath would be wholly counteracted by a prolonged application of cold, and an equally exaggerated susceptibility to cold would result. The cold shock is applied in the form of the shower or douche, or less frequently the plunge-bath. The Russian populace, however, leap into a tank, or the river, or roll themselves in the snow; but they return immediately to the hot steam-chamber.

The duration of the Russian vapor-bath is at first generally fifteen minutes, but after frequent repetition it is prolonged to half an hour or even an hour. The management of the bather on leaving the bath is the same as already described for the ordinary vapor-bath.

In general, the effect of this bath is at first disagreeable, and leaves the patient fatigued and relaxed, but the system soon becomes accustomed to it, and enjoys a sense of peculiar lightness and vigor. The secretions are augmented for some time, and, in some cases, perspiration continues for twenty-four hours. Its action upon the skin may be inferred from the fact that it very sensibly diminishes the weight of the body. Wiegand found that during half an hour passed in the

hot vapor-bath the loss by perspiration was 7 ounces and 2 drachms, and that subsequently, in the antechamber, a further loss of 8 ounces and 6 drachms was sustained. But as this loss is of liquid, it is speedily repaired, and it is found among the Russians that the habitual use of the bath neither enfeebles the system nor diminishes the weight. Sometimes a pustular or other eruption of the skin ensues, which would appear to show either that some morbid material contained in the blood is eliminated through this passage, or else that the heat and friction of the skin are powerfully irritating.

The general vapor-bath should seldom be used, or only with great circumspection in cases of organic disease, particularly of the lungs and heart, whenever the debility of the patient is very great, or when, on the other hand, there exists a plethoric state, or an apoplectic tendency.

Other forms of vapor-bath are in use, such as wooden closets into which steam is admitted from below, and in the door of which an opening is provided through which the patient may pass his head while the rest of the body is exposed to the heat within. Or, the patient being seated, a large blanket may be fastened around his neck, reaching the ground, while beneath it a tube connected with a small boiler surrounds him with an atmosphere of vapor. Or a similar tube may be introduced beneath the patient's bedclothes, which are raised from his body by means of hoops. Similar arrangements may be made for applying steam locally, as to one limb, or a portion of the trunk. In cases of *amenorrhœa*, *dysmenorrhœa*, *spasmodic retention of urine*, *painful hæmorrhoids*, &c., the patient may sit upon a night-stool over a metallic vessel in which water is kept at a proper temperature by means of a spirit-lamp placed underneath it. Watery vapor at the ordinary temperature of the air is sometimes diffused through the atmosphere of the sick-room, or employed by means of an inhaler, both for its own sake, as being less irritating than dry air, and as a means of conveying narcotic and other medicines to the lungs.

Uses of the Vapor-Bath.—In acute muscular *rheumatism*, soon after its commencement, nothing is more effectual in cutting short the attack. Generally, however, internal diaphoretics are found to be more convenient. In chronic articular rheumatism and gout, the vapor-bath alone, or accompanied with frictions and the cold or hot douche, has been found very efficient in removing the pain, stiffness, and swelling of the affected parts. But it must be admitted that its operation is very slow, and seldom curative by itself. In peripheral *paralysis*, or in the centric forms in which the lesion has been as far as possible repaired, the vapor-bath, like other external stimulants, is useful in

restoring muscular nutrition, reviving the nervous energy, and, in case of muscular contraction, diminishing its stiffness. *Anasarca* following scarlatina or suppression of the perspiration is much benefited by this remedy; so too is *scrofula*, when it affects the glands and other superficial parts, particularly in cases remarkable for a harsh and dry condition of the skin. Warm vapor-baths have been used in cases of an imperfect or tardy eruption or retrocession in *exanthematous fevers*. In all chronic *cutaneous diseases*, when the skin is torpid, hard, and dry, or is covered with accumulations of crusts or epidermic scales, it cleanses the integument and renews its vitality. The hot steam-bath, followed by cold affusions, is said to be curative of *profuse sweating* independent of organic disease.

Of Warm Water.

ACTION.—As the capacity of water for caloric is three thousand times greater than that of air, the former is capable of producing the phenomena of heat more energetically than the latter. At the same temperature, water *feels* hotter than air or watery vapor; or, to express the difference more accurately, water at 112° F. acts as a healing agent more powerfully than vapor at 140° or 160° F.

The phenomena produced by the *internal* administration of warm water vary with its temperature. When it is warmer than the stomach (98° to 113° F.), it excites a sense of gentle warmth in this organ, which also diffuses itself more or less over the whole body, and slightly augments the force and frequency of the pulse. The warmth of the liquid promotes its diluent operation, and augments especially the secretions of the skin and the kidneys. Its directly heating and indirectly stimulating action is resorted to when the temperature of the body is unduly oppressed, or when an internal sensation of cold is experienced. Generally it is administered in the form of an infusion of some aromatic plant, or with some alcoholic liquor, and at the temperature above mentioned. To obtain its stimulant effects, a higher degree of heat (120° to 140° F.) is required; but many persons are unable to swallow water as warm as this. It should, however, be remembered that the stomach is less impressionable than the mouth. It also retains hot water much better than what is lukewarm, which, indeed, is proverbially a nauseating liquid. After a copious draught of hot water the circulation is decidedly quickened, as well as the secretions of the kidneys and the skin. The habitual use of hot water as a drink entails debility of the stomach and dyspepsia; but these effects are in some degree mitigated by the addition of aromatic or alcoholic stimulants to the draught.

The *external* action of warm water is best exhibited in the *warm bath*. In the general warm bath it is to be observed that the eutaneous exhalation is arrested, and hence that there is no loss of caloric by the skin. On the other hand, as the body actually gains in weight during the bath, an imbibition or absorption of water must have taken place, although not in a sufficient quantity to modify the circulating fluids materially. The changes brought about result chiefly from the action upon the skin and from the absorption of caloric.

Lukewarm or *tepid* water (85° to 95° F.) is most generally used for bathing. The lower temperature mentioned usually excites a sense of chilliness, and is therefore unsuited for sensitive persons. Tepid baths are chiefly used for the purposes of cleanliness. They do not excite much, if any, perspiration. *Warm* water is most usually employed as a bath, at about 106° F., for at a higher temperature the bath is apt to prove exciting; the sensation is rather burning, the skin becomes red, the pulse and respiration quick, and the head somewhat full. Sweating follows the bath, and is copious when it is encouraged by warm bedclothing, and especially by blankets next to the skin. During this operation there is generally a strong inclination to sleep.

The *local* action of warm water at a moderate temperature (98° to 106° F.) consists in an increase of heat, relaxation of the tissues, and disturbance of the function of the part. The *increased temperature* depends upon the accession of caloric, on the one hand, and upon its impeded escape, upon the other. Relaxation of tissue or diminished contractility is seen when the hand or foot, for example, is held for some time in warm water; the part grows more and more swollen, the veins more prominent, and the skin softer. Hence in bleeding from the hand or foot the flow of blood is promoted by immersing the part in warm water. In like manner poultices and warm fomentations are used to favor the bleeding of leech-bites, scarifications, &c. From its *relaxing properties* water constitutes the best means of cleansing the skin, which it does by removing the impurities contracted from without as well as the detritus of the epidermis, and the oily and saline secretions of the cutis. When thus cleansed, the skin absorbs more actively, a fact that should not be overlooked in the application of mercurial inunctions, cantharides or mustard plasters, &c. The afflux of blood alluded to produces a quickening of the vital processes of the part, and promotes the removal of congestions, exudations, and deposits. When a large portion of the body is subjected to this stimulus, the blood is drawn away from internal organs, and its morbid accumulations are prevented. The *alteration of function* in the part to which warm water is applied involves its sensibility, motility, and secre-

ment power. In the experiment to which allusion was just now made, the swollen hand feels stiff and heavy, and its sense of touch is blunted, but in other respects its sensibility is more acute, and that in proportion as the water used has been hotter. The muscular power of a part long immersed in warm water is impaired; this is manifest in the general muscular relaxation produced by the warm bath, and which is practically induced by physicians in the treatment of luxations, of strangulated hernia, of intestinal spasm, or spasm of the gall-duet, ureter, urethra, &c. Certain secondary effects of warm bathing may be noticed. As the congestion and tumefaction of superficial parts subside, perspiration breaks out, and may become very copious if it is favored by the patient's being kept at rest in bed. Indeed, it constitutes one of the most powerful of sudorifics, and most salutary measures which can be employed on a great variety of occasions, but particularly at the commencement of febrile diseases. At advanced stages, also, of continued fever when the skin grows dry, and the mouth foul, and the intelligence is becoming overcast, tepid baths are sometimes of singular efficacy in restoring suppleness to the skin, in clearing the mind, and sometimes in producing a critical sweat.

Water, and also watery vapor, at a high temperature (boiling water and steam) produce a different class of symptoms, those of *scalding*. When they act upon the skin, acute pain with redness is produced, followed by vesication, and in extreme cases by a destruction of the vitality of the part. If, when, by means of warm water applied for some time, the body becomes heated much beyond its normal temperature, cold water is used momentarily in the form of the douche or plunge-bath, a copious perspiration ensues, provided the cold act but momentarily; for, if its action be prolonged, a chill occurs with congestion of the lungs, brain, or bowels, or else an attack of rheumatism. Or, if, instead of the whole surface being thus exposed to cold, a portion of it only is subjected to the action of a draught of air, some more local derangement, such as ophthalmia, otitis, otalgia, rheumatism of several associated muscles, &c., may result.

Special Uses of the Warm Bath.—The tepid bath (85° to 95° F.) is among the most important of hygienic measures. It should be used from fifteen to thirty minutes at least, and repeated every week or oftener according to the condition of the skin, and the general effects which it produces. At a temperature of 100° to 110°, the warm bath manifests a *stimulant* power in cases of exhaustion after great muscular fatigue, in apparent death from intoxication, from suffocation, or from strangulation by hanging, or, in the case of the new-born child, by the pressure of the umbilical cord, provided there be no evidence

of active congestion of the brain, but on the other hand a cool and flaccid condition of the system denoting exhaustion. Chronic diseases of the skin, and particularly of the scaly forms, are nearly always benefited by the use of prolonged warm baths (at 96° to 100° F.), which remove the thickened epidermis and crusts, soften the tissue of the cutis, and stimulate the cutaneous circulation and secretions. Above the temperature indicated, there is danger lest the morbid activity of the integument should be aggravated. Much, however, will depend upon the duration of the disease and the sensibility of the skin. In chronic rheumatism and gout, warm bathing is decidedly efficacious, and sometimes curative. The higher temperatures are here the best. In paralysis, and particularly paraplegia, this remedy is often successful; but the general bath alone is less so than when it is conjoined with the warm douche. This latter is also peculiarly valuable in rheumatic and arthritic affections, and in sciatica. The soothing influence of the warm bath is pre-eminently useful in the treatment of almost every form of mental derangement, from mania to melancholia. It is essential in the treatment of infantile convulsions. Its revulsive and anodyne qualities are exhibited in the various forms of painful visceral disease already referred to, and in derangements of the gastrointestinal canal and its subsidiary organs, particularly in those which are attended with frequent vomiting or purging. The efficacy of this remedy in the summer complaint (*cholera infantum*) of our climate can hardly be over estimated. In almost all renal diseases the warm bath is a valuable palliative, especially in those which are marked by an altered condition of the urine, such as diabetes, hydruria, albuminuria, &c. The intimate relation between the functions of the skin and of the kidneys appears to explain why the derangements of the latter should be diminished by giving activity to the former.

Partial Warm Baths.—The footbath is one of the most useful of the partial warm baths. Its object generally is to draw away the blood from the upper part of the body, and thus relieve the brain, lungs, or other organs in which pain is felt, or congestion has taken place. Its temperature should not exceed 100° F.; it then excites an agreeable perspiration, and disposes to sleep. But at a higher temperature (108° to 112°), it acts as a direct excitant, heats the whole body, quickens the pulse, and renders the sleep restless and unrefreshing, or even prevents it altogether. The pediluvium may be rendered more active by the addition of salt or mustard, which, is equivalent in effect to several degrees of heat. The water should rise as high as the calves of the legs; the lower limbs should be surrounded by a blanket, including also the foot-tub, and the bath should last from fifteen to thirty minutes.

This remedy is of great service at the commencement of *headache*, *sore-throat*, *coryza*, *pulmonary catarrh*, &c., and is one of the most powerful means of bringing on the *catamenia*, when they are delayed by cold or similar transient cause, and also as an adjuvant to other emmenagogue medicines. It is also of great value as a revulsive in *spasmodic croup*, and, although less so in *pure laryngitis* and *membranous croup*, it ought not to be omitted in these, or, indeed, in the early stage of any inflammatory disease.

The *hipbath* consists of any convenient vessel containing warm water (at 98° to 100° F.), in which the patient can sit so that the pelvis shall be covered by the liquid. Its operation is analogous to that of the footbath, but it is especially appropriate for the relief of disorders of the pelvic viscera. It is used to relieve *strangury*, *retention of urine*, and *uterine colic*, to promote the *catamenial flow*, and also the *hæmorrhoidal* discharge.

Fomentations with warm water, by means of cloths, sponges, spongipiline, poultices, &c., may be classed as local warm baths, and are in common use to relieve the tension of the skin produced by inflammation, abscesses, &c., and thus at once to moderate the morbid process, and assuage pain. They are often preferable to bread and milk, flaxseed meal, and other farinaceous cataplasms, which, by acidifying, tend to make the skin sore, and produce desquamation of the cuticle. Warm fomentations to the *mammæ* have decided *galactagogue* virtues, and are used as a domestic remedy to promote the flow of milk. By means of the sympathy between the *mammæ* and the uterus, such applications to the former, particularly when quickened by stimulant embrocations, or by suction of the nipple, have frequently been effectual in restoring the suspended *menstrual flow*.

Injections of warm water into the *vagina* are employed for the purpose of recalling suppressed *lochia* or *catamenia*, and to alleviate pain in the pelvic viscera. Clysters of the same are also used to evacuate the bowels.

Warm sand-baths are used in some places where thermal mineral waters exist. The patient, in a sitting position, is buried to his neck in sand or gravel saturated with the warm water. Gout, rheumatism, general dropsy, &c., have been treated by this means. A similar method is sometimes used at the sea-shore in midsummer, as we have witnessed it at Cape May.

Boiling water acts like a cautery, and is a powerful revulsive which may be resorted to in extreme cases where it is necessary to produce an immediate and powerful revulsion or stimulation. This is particularly the case in *asphyxia* and in *prolonged syncope*, when the electro-

magnetic apparatus is not at hand. But it should be used with extreme circumspection.

Hot water, at as high a temperature as can be borne without its scalding, has been successfully employed to arrest the development of *panaris*, and also of *frost-bite*.

ELECTRICITY.

DEFINITION.—Electricity is an imponderable agent which appears to reside in all bodies. Its name is derived from *ἤλεκτρον*, amber, for it was first observed, by Thales of Miletus, to be developed by friction of this substance.

HISTORY.—No distinct trace of an acquaintance with the properties of electricity can be discovered until the time of Paracelsus, who attributed curative virtues to the loadstone. Little, however, was added to the vague notions entertained by this philosopher until the invention of the artificial magnet by Max. Hell, of Vienna, about the middle of the eighteenth century, and that of the electrical machine shortly afterwards. Jallabert (1748) was the first to employ the latter instrument successfully for the treatment of paralysis. Soon afterwards Franklin used it for the same purpose, but without permanent advantage. From that date numerous publications appeared, recounting cures by means of the electric bath, sparks, and shocks. In 1780 Cavallo published his *Essay on the Theory and Practice of Medical Electricity*, showing its utility in paralysis, chronic rheumatism, chorea, epilepsy, apparent death, &c.; and in France Poma and Arnaud gave a similar account of its effects in 1787. Two years later, Galvani made the discovery which has immortalized his name. So much more decided were the effects produced by the Voltaic and Galvanic instruments than had been obtained from mechanical electricity, that the latter fell into comparative neglect. The new agents would in all probability have sooner reached the position they have since occupied, had they not formed such ready tools for charlatanism, and thus shared in the aversion inspired by their seeming alliance with the mummeries and impostures of “animal magnetism.” But, as the progress of science continued to develop more and more the essential part played by electricity in all vital as well as merely physical phenomena, the attention of eminent physicians became more strongly fixed upon its therapeutical powers, whose reality, as demonstrated by the galvanic apparatus, could no longer be questioned. But it is chiefly to the discovery of induced galvanic electricity by Faraday, and the invention of the

rotary electro-magnetic apparatus of Pixii (1832), that we owe the considerable advances that have recently been made in this department of therapeutics. The most eminent physicians of Europe have contributed either to the improvement of the electrical apparatus, or to enlarge the list of diseases which it is able to relieve or cure. Of these the most familiar to American physicians is Golding Bird; but many other names will, in the course of this article, be found associated with the progress of medical electricity. Among them Duchenne is the most conspicuous, as well for his scientific elucidation of the subject as for the extension he has given to the curative influence of the electric fluid.

SOURCES AND PROPERTIES.—It is now well known that any disturbance in the molecular condition of bodies may give rise to electrical phenomena. Friction is one of the most common and the longest known of the causes which develop them; but chemical agencies, and the natural magnetic properties of certain substances, are those most frequently employed for medical purposes. The friction of sealing-wax, sulphur, glass, gutta-percha, &c., by means of a silken, woollen, or leather substance, causes them to attract and repel alternately light bodies, such as down, feathers, pith, &c. But the metals, charcoal, vegetable matter, and all moist substances, are incapable of being so excited unless they are *insulated*, that is, unless their connection with the earth is cut off. Thus all bodies may be arranged in two classes, conductors and non-conductors of electricity. Although the former, except when insulated, never display electrical powers developed by friction, yet they constitute the chief sources of electricity developed by chemical action, or galvanism.

It has long been a question among natural philosophers whether the phenomena of electricity are due to a single fluid or to two fluids tending constantly to neutralize each other. But these phenomena are explicable on either supposition. If two pith-balls, suspended by means of silken threads, in contact with each other, are touched by sealing-wax, glass, or other electric, excited by friction, mutual repulsion between them will take place; but if one ball be touched by excited sealing-wax, and the other by excited glass, the two balls will tend towards each other. This phenomenon was early observed, and led to a belief that sealing-wax generated one kind of electricity, and glass another, which were called respectively resinous and vitreous. But the phenomena described, and indeed all which the different forms of electricity present, are explicable upon the simpler theory of a single electrical fluid. This theory originated with Franklin. He supposed that electricity, as a subtle elastic fluid, pervades all nature,

but gives no indications of its presence during the repose of matter. Any disturbance, however, of the natural molecular condition of inorganic or organic matter generates electricity, which then tends to accumulate in some bodies, while it is relatively deficient in others. In the former case it is called positive, and in the latter negative, electricity. As the particles of this fluid are mutually repellent, atoms or bodies equally charged with it tend to separate from one another; and when of sufficiently light material, as in the case of the pith-balls, they actually do so. On the other hand, when it exists in excess in some bodies, and is deficient in others, there is a tendency to the restoration of an electrical equilibrium, and, as in the case of the pith-balls, attraction is manifested; the electric excess on the one side supplies the deficiency on the other, and the balance is restored. In this theory, positive corresponds to vitreous, and negative to resinous electricity, in the theory of two fluids.

Some of the fundamental laws which govern the operations of electricity may be stated as follows: The mutual attraction and repulsion of electrified bodies for one another are in an inverse ratio to the square of the distance between them. Their reaction upon one another is in a compound ratio of the quantity of electricity they possess. The mutual repulsion of electrical atoms for one another causes the fluid to reside on the surface of all bodies in which it exists. Hence, if a metallic sphere be electrified, all portions of its surface will possess the same amount of fluid; but if the sphere be flattened, more electricity will exist at the equator than at the poles. On the other hand, if it be elongated into a cylinder, the two ends of it will be most abundantly supplied, or, if one of these be drawn out to a point, all of the electricity will tend to escape by the latter. In like manner, if a cylinder charged with electricity be furnished with a row of metallic points at one extremity, a constant stream issues from them, and in the dark appears as luminous pencils of divergent rays. When two bodies charged with opposite electricities, or in opposite electrical states, are brought near together, a tendency exists to the restoration of electrical equilibrium, and when this is effected, a spark or flash takes place with a sharp report if the quantity of electricity has been large. This phenomenon is an exact imitation on a small scale of lightning and thunder, as was fully demonstrated by the famous experiment of Franklin with his kite. The clouds and the earth being in opposite electrical states, equilibrium between them is restored with explosive violence.

Owing to the mutual repulsion of electrical particles of the same name, when electricity is accumulated in a body, it *induces* an op-

posite condition in neighboring bodies. It drives their electricity from the adjacent surfaces, so that these latter assume a negatively electric condition; or, if the electricity is withdrawn from a body, it *induces* an over-charged state of the neighboring bodies. The influence or power by which this change is effected is called *induction*, and a distinct idea of it is essential to the comprehension of nearly all electrical apparatus and phenomena. The most familiar example of induction is the Leyden jar. A glass jar is coated within and without to two-thirds of its height with tinfoil, and the internal coating is connected with an electrical machine or other generator of electricity, while the external coating communicates with the ground. In proportion as electricity accumulates on the internal coating, and becomes positive, the external coating loses its natural electricity, or becomes negative. If now the two be connected by means of a metallic or other good conductor, the equilibrium of the electric fluid is instantaneously restored with the phenomena of light (in the shape of a flash or spark), heat, sound, and commotion, those, in fact, of lightning. Now, if the connection between the inner and outer coatings be made partly by certain bodies, the electricity will pass through them, piercing, rending, or inflaming them according to their nature. Cotton dusted with powdered rosin, or wet with alcohol or ether, may be inflamed; water decomposed, or its elements united; metallic wires and other solid bodies heated, melted, or even vaporized; or, if the discharge take place through the living body, as by placing the hands in connection with the interior and exterior respectively of the Leyden jar, or between the opposite poles of galvanic or electric batteries, a shock is felt, especially at the joints, and the muscles are contracted spasmodically.

VARIETIES AND PROPERTIES OF ELECTRICITY.—The varieties of electricity depend upon its mode of development, according as this is by *friction* or mechanical action, by *contact* or chemical action, or by *induction* from these sources, or from magnetism.

Mechanical Electricity.—This is usually generated by the so-called electrical machine, in which a glass plate or cylinder is made to revolve under the friction of leather cushions covered with an amalgam of mercury, zinc, and tin. The evolved electricity is drawn into an isolated metallic conductor by means of sharp points of metal. From this it may be received in the Leyden phial, or any other isolated receptacle, the human body, for instance, placed upon a stool with glass feet, or otherwise insulated. Such electricity is comparatively small in quantity, but highly concentrated, and is hence said to possess a high degree of *intensity*, or to have great power of overcoming

resistance to its progress. It readily produces the disruption of bodies which it traverses, but influences their chemical or atomic composition in a much less degree. In this respect it contrasts strongly with the fluid generated by electro-chemical arrangements. These produce electricity of a low degree of *intensity*, but in large *quantity*, and of wonderful decomposing energy. Thus, the most powerful electrical machine is scarcely competent to decompose a drop of water, while the elements of this fluid are readily separated by galvanic or magnetic electricity.

Application.—The forms under which mechanical electricity is used are the *bath*, the *aura*, the *spark*, and the *shock*.

The *electric bath* consists simply in placing the patient upon an insulating stool connected with the prime conductor. His whole body is charged with electricity. The hairs of his head become mutually repellent and stand on end; from his eyelashes, the tips of his fingers, and nose, and from other prominent parts, an aura issues, which is luminous in the dark. In some cases the circulation is quickened; the secretions generally become more active, and perspiration breaks out.¹ But these phenomena very probably depend upon the patient's agitation, for Giacomini has related that, according to his observations, neither the pulse, the secretions, the respiration, nor the mental condition, undergo any change.² It is affirmed by the author just named that, when an insulated person is connected with the rubber of the electrical machine while the conductor communicates with the ground, he is exhausted of his electricity, and so marked a sedative effect is produced upon his system, that inflamed portions of his skin grow pale, and headaches and neuralgic pains are dissipated by this electrical depletion. These assertions, so readily susceptible of confirmation if correct, have not been supported by other writers, and very certainly no analogous phenomena are observed in healthy persons under the conditions named.

The electric *aura* is produced by the action of a pointed conductor either of brass or wood. By connecting this body with the prime conductor by means of a chain, and connecting, at the same time, the patient's body with the rubber of the machine, a pencil of electric rays is projected from the point against whatever part of the integument it is desired to act upon. In this manner he receives positive electricity. On the other hand, if he is placed on the insulating stool in connection with the prime conductor, and the points are moved near the surface of his skin, positive electricity is withdrawn from him. Finally, if,

¹ G. BIRD, Guy's Hosp. Rep., No. xii. p. 85.

² Bibliothèque du médecin praticien, xiv. 90.

while insulated, points connected with the rubber are presented to his body, his electricity is withdrawn by them.

The *spark* is obtained for medicinal purposes by insulating the patient, in connection with the prime conductor, and bringing a blunt metallic body near the affected part. Sparks pass from the latter to the former, occasioning a stinging, pricking, or tearing sensation, according to the intensity of the discharge. A small, circumscribed wheal surrounded by a little inflammatory blush is produced in delicate skins. In certain diseases (paralysis, rheumatism), Cavallo drew sparks, by means of a metallic ball, through flannel applied over the affected part in one or several folds according to the power of the machine employed.

The *shock* is produced by including a portion of the body in the circuit formed when a Leyden jar or battery is discharged. For example: if a chain communicating with the outer coating of the jar is held in one hand, while the other touches the knob of the jar, a discharge will take place through the arms and chest. It produces a disagreeable spasmodic jerking, accompanied by a sense of contusion, which pervades the parts traversed by the charge, or, when the charge is a feeble one, in the parts only nearest to the jar. If a discharge is made through a nervous trunk, a severe contusive pain is experienced, followed by numbness of the part. The discharge of an electrical battery, or assemblage of Leyden jars, may kill small animals, dogs, and even men. The parts attacked by the electricity are injured in the same way as by lightning, and exhibit signs of burning, wheals, or punctures, and the limbs are usually relaxed. No internal lesion is discovered after death except that the blood is not coagulated.

These modes of electrization are quite superseded by galvanic and voltaic electricity.

Galvanic or Voltaic electricity is developed by the contact and chemical action of dissimilar substances. In 1789, Galvani, of Bologna, discovered, in some experiments upon frogs, when a nerve and a muscle were joined by a metallic medium, that muscular contraction was excited. He at first supposed the cause of this movement to be the nervous force, but Volta proved it to be electricity excited by the contact of the substances mentioned, and that the contraction was still more decided when dissimilar metals were used, as, for example, zinc and copper. It is now certain that chemical action is the source of the electricity in the above experiment, and that of the two metals employed the zinc is the one chiefly attacked, and that the copper is the recipient or condenser of the electricity developed. Several metals, such as lead, iron, tin, bismuth, and antimony, have the same reaction as zinc,

and hence are called electro-positive; while others react like copper, as, for example, gold, silver, and platinum, and hence are called electro-negative. This mode of developing electricity is now become familiar in the galvanic battery. In its simplest form it consists of a single pair of plates, *i. e.* of a copper and zinc plate placed perpendicularly and apart in a glass vessel containing slightly acidulated water. While they remain unconnected, no phenomena are noticed, but if they are connected above by means of a copper wire, the oxygen of the water immediately attacks the zinc, hydrogen gas escapes in bubbles, and the electricity which is developed accumulates on the copper plate, or rather a circulation is established from the zinc to the copper, through the water, and from the copper through the wire back to the zinc. The most oxydizable metal of the two employed is that which furnishes the supply of electricity; hence, in the arrangement of plates just described, the zinc is the positive pole and the copper the negative pole. When the wire which completes the circuit just described is divided at any point, the passage of electricity between its two extremities occasions various phenomena accompanied by light, heat, and chemical effects.

Galvanic induction, like induction from mechanical electricity, may be produced in the following manner. If a wire in its natural state is brought near to another which is traversed by a current of galvanic electricity, a change in the electrical condition of the former at once takes place; a current is immediately established within it which has a direction opposite to that of the primary current; and if the two wires be brought very closely together a spark will pass between them. When a number of pairs of metallic plates, such as have been described, are associated so that the negative pole of one shall be connected with the positive pole of another, and the extreme pairs by an interrupted conductor, phenomena are developed of the same kind as, but of much greater activity than, in the case of a single pair, because the *quantity* of electricity forming the current is very great. Quantity, however, is proportioned to the area of metallic surface employed in each pair of plates; *intensity*, on the other hand, depends on the number of pairs composing the battery. These phenomena are mainly chemical and calorific, as distinguished from those of the electrical machine, which are chiefly mechanical. The most intimate chemical compounds are decomposed; the alkalies, for example, were proved by this agency to be compounds of a metallic base with an electro-negative body. When the poles of a battery terminate in charcoal points, and these are brought very near to one another, a more brilliant light is produced than by any other artificial means. If metallic plates attached to the

opposite poles are applied to the skin while the battery is in action, a superficial eschar is at length produced, such as the actual cautery occasions. An uninterrupted current from a strong instrument gives rise to a sensation of heat, and a degree of pain which at length becomes insupportable. When the current, however, is intermittent, three separate effects are observed, viz: on its entering the body, on leaving it, and in the interval between the two.¹

The physiological action excited by breaking the circuit is so slight as to be imperceptible, except when the largest batteries are used, but that produced by the entering current is most strongly marked by the development of muscular contractions. The physiological action between these two is due to the continuous current, and is that local irritation, amounting even to cautery, which has already been described. Galvanic electricity is peculiar in the energy with which it acts upon the retina. Its currents passing through the fifth pair excite luminous sensations, of which one is vivid, another feeble, and the third more feeble still; the first corresponds with closing the circuit, the second with its interruption, and the third with the intermediate period.

Magnetic Electricity.—Induction Electricity.—The ancients were acquainted with the power of the *loadstone* to attract iron. This mineral, an oxide of iron, was called by the Greeks *μαγνης*, and from this word magnet is derived. The *polarity* of the magnet, or the directive power by which it tends to assume a north and south direction, was unknown in Europe until the twelfth century, when a knowledge of the mariner's compass, derived from the Chinese through the Tartars, was brought from the East by the crusaders.²

The general phenomena of magnetism and electricity are very analogous; thus similar and dissimilar ends, or *poles*, of magnets, mutually repel and attract; bodies are rendered magnetic by *induction*, and the sensible distribution of magnetism, like that of electricity, is superficial. But magnetism is incapable of *transference*, since a magnet becomes stronger, and therefore gains instead of losing power when used to impart magnetism to another body. Ordinary magnetism, also, can be readily developed in only a few metals; and it is permanent in steel, but transitory in soft iron.

If a permanent magnet be furnished with a soft iron cylindrical armature bent into the form of a horseshoe, and each arm of the latter be wound round with insulated copper wire, having its two extremities left free, and if now the magnet be made to revolve rapidly, so as to bring its poles alternately near to either end of the armature, the soft

¹ DUCHENNE, Arch. Gén., 4ème sér., xxvi. 70; De l'Electrisation localisée, Paris, 1855.

² McCULLOH, Booth's Enc. of Chem., p. 554.

iron of the armature becomes alternately magnetized with opposite polarity, and currents flowing in opposite directions are *induced* in the copper wire around it. If a closed circuit be formed by connecting the free ends of the wire, all of the induced currents will be transmitted; but if by any suitable mechanical arrangement the contact be broken during one-half of every revolution, one-half of the currents will be interrupted, and those transmitted will all have the same direction. It will readily be understood that the circuit may be formed partly of wire and partly of any other conductor, as the human body. In the latter case electric shocks will be perceived in the parts between the extremities of the wires. In this apparatus the electricity is *induced* in the wires which surround the armature, and is not derived immediately from the magnet itself. In other forms the wires are wrapped around the arms of the magnet, and then the armature being applied, neutralizes the electricity of the magnet and liberates that of the wire coil.

Another, and the more usual form of induction electricity, is that indirectly generated by the action of a *galvanic current*. A bundle of soft iron-wire, or a bar of soft iron, is placed in the centre of a wooden reel or bobbin, around which is wound a quantity of stout insulated copper wire, having its two ends free, for the purpose of being connected with a single pair of plates of copper and zinc exposed to chemical action. Over this are wound about 1300 feet of very thin insulated copper wire. The two ends of this coil are furnished with directors for the purpose of being applied to any portion of the body or limbs required. If, then, one end of the inner coil be removed from the battery, the constraining inductive force previously exerted on the outer coil is removed, and all the electricity naturally present in it is discharged through the portion of the body touched by the director, producing an electric shock. By adapting a piece of apparatus for mechanically breaking contact with the battery employed, a series of shocks can be sent through a limb, either very slowly and mildly, or at the rate of two thousand or more a minute; producing such a rapid succession of discharges as to give rise to a sensation amounting to insufferable torture.¹ Instead of the secondary current here described, the primary, or that obtained from the interior coil of wire, is sometimes used; but, in either case, every interruption of the circuit is attended by a discharge, one at the instant of making, and the other at the moment of breaking, the contact.

The force of the discharge may be regulated by the position of the soft iron core; the more it is withdrawn, the less powerful will be the

¹ BIRD, loc. cit.

shock. Or the length of the secondary coil may be increased or diminished, by which means the machine becomes more or less powerful. Or, finally, a tube containing water may be introduced into the circuit, and the ends of the wires within it made to approach or recede from one another, according to the strength of the shock desired. Induction currents, of whatever power, produce little or no change in the texture of the skin; a little erythema may occasionally be observed. According to Duchenne, the primary and secondary currents are not possessed of identical powers. The latter excites the retina in a higher degree, particularly when the magneto-electric apparatus is used, and also the general sensibility of the skin, while the primary current influences muscular contractility more decidedly.¹

ACTION OF THE SEVERAL FORMS OF ELECTRICITY.—Allusion has already been made to the influence alleged by Galvani to be exerted upon a person insulated and in connection with the rubber of an *electrical machine*, and its reality was held to be doubtful. As to sparks from the prime conductor, they exert but a feebly stimulating influence upon the skin, or upon the contractility of the superficial muscles. The shocks produced by means of the Leyden phial are more energetic and effectual; but this method is disagreeable on account of the muscular and nervous commotion, as well as the irritation of the skin, which it occasions.

Galvanic electricity acts chiefly upon the skin, exciting more or less inflammation when its current is continuous; or, if the circuit is made by means of acupuncture needles, the decomposing action of the fluid may be set up within the tissues. In this way aneurisms have been cured. Reference has been made to the influence of this agent upon the eye, showing that, when properly applied, it acts as a powerful stimulant to the retina. Yet it is not without risk. If, while the eyes are closed, one pole be connected with the hand, for example, and the other applied to the forehead, temple, or cheek, flashes of light are perceived. It has happened, however, that permanent amaurosis has been produced by this operation when too powerful a charge was used. When the muscles are to be excited, an interrupted current must be used; but it has been suggested that danger is to be apprehended from the calorific action of galvanic electricity even in this form. If the interrupted current is transmitted in the course of the nerves (direct current), it produces more muscular contraction than when it has the opposite direction (inverse current). In experiments upon animals, after removal of the nerves, the effects upon the muscles are the same,

¹ L'Electrisation localisée, p. 101.

whatever the direction of the current. Obvious physiological effects are observed only on completing or interrupting the galvanic circuit through the body, and are the most marked on completing it.¹ When the current is transmitted along the spine, certain savors are said to be perceived, and painful sensations in the stomach, bowels, &c. Its action upon glands is to augment their secretion. If one pole is connected with the mouth, and the other with the anus, a gentle warmth and movements are felt in the abdomen, then a sense of weight in the rectum, and after ten or fifteen minutes an alvine evacuation.²

Undoubtedly the different forms of *induction machines* have a great advantage in being free from the objections against the other apparatus which have been mentioned. Induction electricity is capable of producing all degrees of altered sensibility, from the severest pain to the slightest, without disorganizing or leaving any permanent trace upon the skin; and therefore its application can be renewed as often as desirable, and whatever the patient's susceptibility may be. The primary current, differing from the secondary in its qualities, may be substituted for the latter, particularly in electrifying the face, or parts near the eye. The secondary current has its peculiar application in muscular paralysis and other musculo-nervous affections, on account of its intensity independently of all healing action.

MODES OF EMPLOYING VOLTAIC AND MAGNETIC ELECTRICITY.—Voltaic or galvanic electricity may be administered, like mechanical electricity, by causing the part of the body which is to be acted upon to form a part of the electrical circuit. In order to facilitate the transmission of the fluid, the skin should be moistened with water, or with salt and water, or covered with a piece of flannel cloth saturated with either liquid. If the electricity is to be transmitted through a limb, the hand or foot may be immersed in a vessel of water, or salt and water, and the corresponding or the opposite extremity in another similar vessel, while the poles of the battery are connected with the vessels respectively.

Superficial Electrization.—There are several modes of applying magnetic or induction electricity, according to the sensibility of the part acted upon. These have been particularly described by M. Duchenne. The first he calls the *electrical hand*. A moistened sponge is contained in a metallic cylinder screwed to an insulating handle. The cylinder, which communicates with one of the poles of the apparatus, is placed upon some portion of the body which possesses slight sensibility, as

¹ TODD, Med.-Chir. Trans., xxxvi. 460.

² DONOVAN, Dub. Quart. Journ., Feb. 1847, p. 103.

the sacro-lumbar junction. The other cylinder is held by the operator, who, after having dried the skin thoroughly, passes the back of his hand rapidly over the portions of the skin which he wishes to stimulate. The next instrument consists of a *solid metallic body* shaped like an olive, or having one of its extremities pointed. This also is screwed to an insulating handle, and is intended to act upon the smaller muscles, as those of the face, the interosseous, &c., and on the nerves. It is covered with moistened agaric, and presented by its point to the skin. This latter, when delicate, is previously dried by means of an absorbing powder; but, on the other hand, if thick and hard, it is slightly moistened, and the instrument is applied to, or moved over, its surface. Sometimes solid cylindrical bodies are employed, which are applied to the skin, and intended to act chiefly upon it. In other cases the pointed conductor is held for a short space in contact with the skin, where it produces a sensation like that of a burning point thrust into the body. The third instrument consists of a bundle of fine wires arranged like a *brush*, and also insulated. This may be moved over the affected part, and occasionally struck lightly upon the skin, or else allowed to remain in contact with it as long as it can be borne. The latter mode is known as the *electric moxa*, and is the most powerful form of local stimulus. These three methods of galvanization differ from one another in their effects. The electrified hand passed over the face produces a sensation as if a rough brush were tearing the skin. When the electric brush is allowed to remain in contact with the body, it seems as if burning needles were thrust into the flesh; and when struck lightly upon the skin, its effect is only less in degree because of shorter duration.

Muscular Electrization.—We are indebted to M. Duehenne for a knowledge of the mode in which deep-seated parts can be electrified without affecting the skin. If two *excitors* (the metallic cylinders filled with sponge, described above) in a dry state are applied near to one another upon the dry skin, particularly where the epidermis is thick, the electric current will pass between them without penetrating the skin, and accompanied with sparks and crackling. But if one of the excitors is moist and the other dry, a superficial sensation will be felt under the dry excitor, showing that the current has not penetrated the skin. If now the skin under the dry excitor be slightly moistened, a stronger sensation will be perceived. Finally, if the excitors and the skin are both moist, there will be neither sparks, nor crackling, nor a burning sensation, but, on the other hand, muscular contractions will be excited, or various forms of pain according as a muscle, a nerve, or a bony part, has been acted upon. This fact serves as a

foundation for the whole art of localized galvanization. In order to stimulate certain muscles or nerves which are deficient in power, it is necessary that the operator should be acquainted with the anatomical position of the affected parts. For the stimulation of nervous trunks, the olive-shaped button covered with moistened agaric is to be preferred; but when muscles are to be electrified, the moistened cylindrical excitors are to be placed upon them. These are held in the left hand, one of them between the thumb and forefinger, and the other between the middle and the ring finger, while the right hand regulates the intensity of the current from the machine, according to the susceptibility of the patient, or of the part acted upon.

Visceral Electrization.—Most of the internal organs are accessible to galvanic action, either by the neutralization of the electric fluid within it, or by the stimulation of the nerve which regulates its vitality. The muscles of the rectum and anus, and even of the bladder and uterus, may be stimulated by introducing excitors into the organs named; the pharynx and larynx may be indirectly excited; the stomach, lungs, and heart, through the branches of the pneumogastric; the diaphragm by the phrenic nerve. The organs of the senses may, in like manner, be subjected to the electric influence. The limits of this article will not allow of more than this simple indication of the fact, but the reader who has been interested by so imperfect an exposition of a highly attractive and important subject, will find more ample details in the work of M. Duchenne.

REMEDIAL EMPLOYMENT. *Paralysis.*—There is no class of affections in which the curative powers of electricity display themselves so strongly as in palsy. But here, as might be expected, a great difference is to be observed according to whether the paralysis depend upon a peripheral or a central cause. When cerebral hemorrhage or softening, or any other lesion, has broken up and disorganized the tissue of the brain, it is vain to expect that the muscles which derive their power from the injured part can ever be restored to their original condition. Electricity can only incite to action organs that are not wholly disabled, and in which a power of regeneration exists. Hence peripheral paralyses are those in which the curative powers of this agent are most decided and prompt in their operation; next in order come those in which the central lesion is one susceptible of repair; and finally, cases of disorganization of the nervous centres are quite beyond its power to cure.

It may be not amiss to inquire briefly in what manner electricity affects paralyzed muscles. In hemiplegia, for example, it is generally observed that the paralyzed muscles do not respond as readily as the

sound ones to the electric stimulus. Sometimes, it is true, when muscular rigidity follows soon upon the paralytic attack, indicating an irritation around the clot, the irritability of the muscles seems to be increased; but this condition is due to the excited molecular action of the brain, and is identical with that spontaneous jerking of the limbs frequently observed under the same circumstances.¹

In opposition to this result obtained by Dr. Todd, Dr. Marshall Hall objected that the perturbative influence of the electro-dynamic apparatus was employed, and alleged that when the less intense discharges of the galvanic trough are resorted to, they excite contractions in the paralyzed muscles first.² But this conclusion has been set aside by the result of fourteen experiments in cases of paralysis made by Dr. Todd, with the galvanic current. In nearly all of these cases the galvanic stimulus failed to develop a superior degree of excitability upon the paralyzed side, whatever degree of power was used.³ M. Duchenne obtained nearly identical results with these, for he has shown that the irritability of the muscles is unaffected, whether the sensibility be preserved or not, and whether or not the nutrition of the muscles is impaired.⁴

In the following account of the curative effects of electricity in paralysis we shall have reference to the older methods of applying it, and also describe the results obtained by Duchenne's method.

The mode of using the remedy influences its results in a great degree. For example, Dr. H. P. Dewees' was, it is believed, the first to state that when reparative or nutritive effects are needed, as in wasting of the muscles, the continued galvanic current, and not the interrupted electro-magnetic current, is the most efficient, seeming to act like friction with stimulating liniments. He also found that under these circumstances the current should have the same direction as the tide of sensation from the periphery to the centre. On the other hand, when the muscles have lost their power, but retain their bulk, the interrupted centrifugal current excites their contraction and gives them functional exercise by the operation of its intermittent stimulus. Precisely similar views were afterwards set forth by Terzi.⁶ To produce, he says, a chemico-dynamical action, the Voltaic pile is best suited, and one with few elements, so that a feeble current is induced. But where an almost exclusively dynamic action is in view, mechanical electricity is to be preferred. He directs that in sensorial paralysis the currents should follow the direction of the sensations, *i. e.* from

¹ Todd, *Med. Chir. Trans.*, xxx. 207. ² *Ibid.*, xxxi. 149. ³ *Ibid.*, xxxvi. 459.

⁴ *Archives Gén.*, 4ème sér. xxiii. 283. ⁵ *New York Journ.*, 1847, viii. 304.

⁶ *Br. and For. Med. Chirur. Rev.*, Apr. 1850, p. 558.

below upwards, while in motor paralysis the contrary course should be preferred. By means of acupuncture needles, he also localizes the electric action. As has been seen, this last result is obtainable more easily by Duchenne's excitors.

In all cases of paralysis which are independent of structural lesions of the nervous centres, hopes of restoring activity to the muscles may be entertained. But the ordinary revulsive methods are first to be exhausted of their powers before resorting to electricity. When the muscular debility appears to yield no further under such remedies, or when the gain of power is very slow, a resort to the electrical stimulus is indicated. A succession of shocks from the electrical machine transmitted from the spine to the extremity, and carefully proportioned to the patient's susceptibility, has sometimes been followed by a cure. The interrupted current from the electro-magnetic machine is more effectual. In some cases of peripheral paralysis a long-continued feeble stream has been sufficient to restore the power of motion, as in those reported by Dr. Miller, of Baltimore,¹ in 1834. One was a case of paraplegia, and the other of general paralysis, and both were cured by a single pair of plates, applied over the blistered portions of the skin, the one over the back of the neck and the other on the leg. After muscular rheumatism, and also from blows upon a muscle, its fibres waste and loss of motion results. If this state is neglected, it is very apt to become permanent. All excitants are calculated to relieve it, and electricity among them. The best mode of applying it is by means of the excitors of M. Duchenne, or by insulating the patient and striking lightly upon the part with a wire brush. It may here be mentioned that *muscular rheumatism* itself in the subacute or chronic form is generally relieved with great rapidity by the same mode of treatment.

Paralysis of the Bladder and Rectum. After parturition, when retention of urine occurs from loss of power in the bladder, galvanism has been used successfully to restore it. It seems to have been first employed for that purpose by Dr. Goodwin of Manchester.² Dewees cured a case of paralysis of the bladder and rectum, produced by concussion of the spine, by passing a continuous current from the rectum and spine to the supra-pubic region, and through the urethra by means of a silver catheter, the positive pole being placed upon the spine. A similar one is related by Löschner. More recently Duchenne has reported the cure of a case of prolapsus of the rectum in a man forty years of age, and who had suffered this infirmity from infancy.³

¹ Am. Journ. of Med. Sci., xiv. 322.

² RANKING'S Abstract, i. 176.

³ Bull de Thérap., xlv. 562.

Dr. Golding Bird employed the remedy successfully in the affection known as "*dropped hands*," a paralysis of the extensor muscles of the wrists and hands. He sometimes applied one pole to the spine and the other to the palsied muscles, or drew sparks from the latter; but generally sparks were drawn from the upper part of the spine over the origin of the nerves forming the axillary plexus.¹ In *aphonia*, Grapengiesser of Berlin used the simple galvanic circuit. A case was cured by him in which loss of voice and hoarseness had continued for four years, and which had been unavailingly treated with counter-irritants, &c. He vesicated both sides of the larynx, and attached a zinc plate to one and a silver plate to the other. When a connection was made between the two, violent burning sensations and convulsive movements of the larynx were produced. When the circuit remained closed, the application was less painful than when it was alternately closed and opened. It was continued for a quarter of an hour. After dressing the sores, which discharged copiously, the spasm continued for some minutes. In two hours the patient began to speak more audibly, but the improvement ceased after a few days. The application was then renewed, and the voice was permanently restored. It is only in nervous aphonia, and that resulting from subacute laryngitis without structural lesion, that this remedy is of service.²

In the paralysis which occurs in *hysterical* persons this remedy acts so decidedly and promptly as "strongly to impress those who are watching the case with a conviction that the whole disease is simulated."

Amaurosis, depending upon paralysis of the fifth pair rather than of the optic nerve, has frequently been cured by passing electricity across the orbit. A silver probe connected with the positive pole of the battery is introduced into the nostril, while the opposite pole is brought into connection with the frontal nerve. The operation, however, is very painful, excoriating the nostril. The current may also be passed between the temples, or from the occiput to the superciliary or infra-orbital foramen. In connection with this subject, a case may be alluded to which is reported by Prof. Olmstead. A man, who is described as laboring under "paralysis of the face and eyes," was struck by a flash of lightning. He fell senseless, and for several hours was deprived of the use of his legs, but his previous disease was cured. Mr. Ware considered electricity more useful in amaurosis from the effect of lightning on the eyes than in any other variety of the complaint. The cases related by Mr. Hey and Mr. Ware afford sufficient

¹ Guy's Hosp. Rep., No. xii. 99.

² Dublin Journ., Feb. 1847, p. 108.

ground for believing that electricity may occasionally prove highly serviceable in this disease.¹

In *nervous deafness* of the torpid form, which is in reality a rare disease, this agent has been recommended by several writers, who, however, have had little or no opportunity of appreciating its efficacy. Than mechanical electricity, says Frank,² no remedy is more inefficacious; and as for galvanism, no real aurist has observed any really good results from its use. Its introduction into this department of medicine was due to theoretical considerations growing out of the supposed identity between electricity and the nervous fluid. Itard ascribes the transitory success it enjoyed to the power of a lively faith, which was as short-lived as the enthusiasm from which it sprang.

Before passing to consider the application of electricity in the treatment of other diseases, it is proper to allude to the peculiar method of Duchenne in the treatment of paralytic affections. The capital point has already been dwelt upon, viz., that he applies the electrical stimulus directly to the affected muscles themselves by means of the positive and negative excitors, placed at short distances from each other. Thus, in paralysis of the forearm and hand, each individual muscle is as far as possible subjected to direct stimulation, even to the small muscles that move the fingers. But by this plan it is evident that the electric fluid is not likely to act upon deep-seated muscles. To reach them, it is necessary to render the nervous trunks which supply them conductors of the electricity; in other words, to adopt the ordinary method.

Neuralgia.—In 1834, Dr. Thomas Harris, of Philadelphia, reported several cases of neuralgia either cured or relieved by means of the action of a single pair of zinc and silver plates, the one being applied at the back of the neck, and the other near the knee, upon moistened sponge in contact with the denuded cutis.³ Other practitioners have employed galvano-puncture. But neither remedy appears to be called for in a disease in which so many others possess superior efficacy.

Angina Pectoris.—It would appear, from two cases of this disease published by Duchenne, that sometimes, when independent of cardiac disease, it may be cured by electro-magnetism. This physician applied one of the poles of the battery between the shoulders, and the other to the anterior part of the chest.⁴

In *hysteria* the application of the galvanic or electro-magnetic shock has sometimes arrested the paroxysms. Such a case is reported by

¹ MACKENZIE, Dis. of the Eyes, 2d ed., p. 917.

³ Am. Journ. of Med. Sci., xiv. 384.

² Ohrenkrankheiten, p. 144.

⁴ Bull. de Thérap., xlv. 241.

Dr. H. L. Byrd. A young girl, twelve years of age, had a violent hysterical paroxysm every afternoon, and numerous active and even severe remedies had been employed in vain, when it was determined to use the electro-magnetic battery, and apply one of the poles to the occiput, and the other to the sacrum. The first application arrested the formation of a paroxysm, and prevented the return of any others.¹

Chorea was very successfully treated with this agent by De Haen in 1761, by Fothergill in 1779, and more recently by Dr. Addison² and Golding Bird.³ The plan of the latter was to draw sparks from the spinal column every other day for five minutes at a time, or until a papular eruption made its appearance on the skin. In thirty-five out of thirty-six cases there was either a complete cure, or very marked relief. In most of them, also, no other remedy was employed. It is worthy of remark that the mere transmission of an electric current through the spine is quite inoperative; the passage of the sparks through the skin, and perhaps their counter-irritation of the integument, is the chief element of cure. Dr. Hughes also reports very favorably of this method. He has seen it effect a marvellous change when the body and mind were both becoming feeble under the progress of the disease and the failure of other remedies.⁴ Its application, however, requires caution, for in weak, nervous, timid children it is apt to excite alarm and increase the agitation. In *scrivener's spasm*, so called, a disease in which the flexor muscles of the fore and middle finger and the thumb of the right hand are affected with spasmodic twitchings and contractions whenever an attempt is made to write, some benefit appears to have been derived from electrifying the extensor muscles, or from passing a current of magnetic electricity through the arm and hand.⁵

Constipation.—The stimulant properties of electricity render it a valuable agent in overcoming torpor and obstinate constipation of the bowels under certain conditions. Aehard, of Berlin, was the first to propose electricity for the relief of these conditions. In 1847 Dr. Dewees⁶ stated that, whether the torpor be associated with excessive dryness of the intestinal mucous membrane, as shown by the scybalous form of the feces, or whether it depends upon a leuco-phlegmatic habit, in which the secretion of thick, tough mucus prevents the membrane from feeling the stimulus of the feces, the action of galvanism

¹ Charleston Journal, iii. 412.

² Guy's Hosp. Reports, vol. ii. 1837, p. 493.

³ Ibid., Apr. 1841, p. 84.

⁴ Ibid., Oct. 1846.

⁵ LÖSCHNER, Prager Vierteljahrschrift, i. 61; MEYER, Electricität, p. 110.

⁶ N. Y. Journ., viii. 304.

is equally curative. In either case it augments the secretion of the intestine while urging it to propel its contents. Two years after the publication of Dr. Dewees's essay, similar indications were laid down by Dr. Cumming, of Edinburgh.¹ He mentions particularly the "membranous, fibrinous matter" that is discharged, and advised the daily use of the electro-galvanic apparatus for the space of a quarter of an hour. Constipation depending upon spinal paralysis has been relieved in the same manner. A case of paraplegia is reported by Terzi, in which no alvine evacuation had taken place for a fortnight. The conductor of the positive pole was placed in the mouth of the patient, while that of the negative pole, covered with moistened cloth, was introduced into the rectum. The machine employed was a galvanic one of eight pairs of plates, and the current was maintained for twenty minutes. Abdominal movements ensued, but no stool. On the next day the application was renewed, and then, with the aid of a clyster, an abundant evacuation was procured.²

Amenorrhœa.—In this disease the curative influence of electricity is strongly marked whenever the deficient menstruation is independent of a constitutional cause, or survives its removal. A curious example of the effects of lightning on the catamenial function is related by Dr. Le Conte, of Savannah.³ Four females were struck by the same flash of lightning, two were killed, and of the others, one who had previously been quite regular became affected with disordered menstruation, and the remaining person, who was seventy years of age, soon afterwards had a bloody uterine flow, which returned regularly, at monthly intervals, for at least a year.

When, then, there is no constitutional disease, or when the health and digestion have been improved by tonics, laxatives, and exercise, a few shocks from the Leyden jar, and often a single one will be sufficient to produce menstruation. Indeed, to use Dr. Bird's expression, in electricity we possess the only direct emmenagogue which the experience of our profession has furnished us with. The electrical treatment should be commenced about a week previous to the menstrual period, and every day ten or a dozen shocks should be passed between the sacrum and pubes. Dr. H. P. Dewees says of this remedy, that in cases of simple obstruction or retention, it is most certain and powerful. Numerous examples of its power are given by Mr. Clarke,⁴ Hervey,⁵ and others.

¹ Lond. Med. Gaz., Dec. 1849, p. 969.

² Brit. and For. Med.-Chir. Rev., Apr. 1850, p. 559.

³ N. Y. Journ. of Med., iii. 296.

⁴ GRAVES' Clin. Med., p. 421.

⁵ Bull. de Thérap., xlv. 81.

Uterine Hemorrhage.—Electricity appears to have been originally proposed to control this accident by Dr. Radford, of Manchester, and was first employed by him successfully, in a case of flooding from uterine inertia during labor.¹ He applied one conductor of the electro-magnetic apparatus to the os uteri, and the other to the abdominal parietes over the fundus uteri, and used both shocks and currents, to which the uterus immediately responded by contracting. Other cases of equal success have been reported by Mr. Dorrington,² Dr. Johnson, and Mr. Wilson,³ so that no doubt can exist in regard to the value of electricity in these dangerous cases. Dr. H. P. Dewees has employed it to restore and stimulate a patient exhausted, and in danger of dying from hemorrhage after labor; it succeeded, although other remedies had entirely failed.

To excite uterine contractions, electricity was recommended as early as 1786, by Bertholon. In 1803, Herder proposed its use in cases of tedious labor from uterine inertia, and was followed in recommending it by Basedow, Stein, and Kilian. In 1834, Ramsbotham suggested his belief that shocks from a galvanic battery "would excite the flagging powers of the uterus under labor, and perhaps even induce action *ab initio*."⁴ In 1844, Drs. Höninger and Jacobi succeeded in bringing on labor by the electro-galvanic apparatus after other means had failed, and Schreiber pointed out the advantages which it possesses over other excitors of uterine contraction.⁵ In 1846, Dr. Simpson instituted some experiments with a view to determine the influence of galvanism upon uterine inertia, but, strange to say, he obtained only negative results. He concluded that it is not a means which can in any degree be relied upon for the purpose in question, and is so far practically entirely useless as a stimulant to the parturient action of the uterus.⁶ Nevertheless, the proof of its utility accumulated; Cleveland employed it with perfect success in uterine inertia,⁷ and Radford had already suggested that it might even be competent to induce premature labor.⁸ Dr. Barnes has furnished examples of its use in the induction of premature labor, in uterine inertia, in the third stage of labor, and in hemorrhage.⁹ The advantages of the remedy over ergot may be thus summarily stated. Electricity is more to be depended upon than ergot, it acts more speedily, may be more exactly

¹ RANKING'S Abstract, vol. i., Art. 113, from Prov. Med. Journ., Dec. 1844.

² Ibid., vol. iii. Art. 82, from Prov. Med. Journ., March, 1846.

³ Ibid., vol. iii. p. 235.

⁴ Lond. Med. Gaz., xiv. 87.

⁵ Vierteljahrsschrift für die prakt. Heilk., ii. 167.

⁶ Edinb. Month. Journ., July, 1846, p. 46.

⁷ Lond. Med. Gaz., June, 1847.

⁸ RANKING'S Abs., vol. i., p. 176.

⁹ Lancet, Nov. 1853, p. 456.

proportioned to the requirements of the case, and the contractions it produces are more analogous to natural labor-pains than those of ergot, which expose the child to undue compression.¹

Other Uterine Affections.—Electricity has been successfully employed to cause the expulsion of polypi, hydatids, &c. from the womb.

Asphyxia.—In 1826, Leroy d'Etiolles performed some experiments on animals asphyxiated by submersion, showing that when the action of the diaphragm is excited by an interrupted current, respiration may be re-established, and life restored.² Numerous examples are on record of persons restored to life after apparent death, or insensibility produced by drowning, carbonic acid fumes, narcotic poisons, &c. Dr. Williams relates the case of a person poisoned by laudanum who was instantly restored to consciousness (after evacuating the stomach), by passing shocks from an electro-magnetic machine across the chest.³ Dr. Russell reports the case of a child, two months old, poisoned by eleven drops of laudanum. It appeared to be almost dead. One pole of the electro-dynamic apparatus was applied over the upper cervical vertebræ, and the other upon the ensiform cartilage. Inspiration followed, and then movements of the limbs. The treatment was continued for an hour and a half, when respiration was established; but the child sank, and died.⁴ A case is reported by Dr. T. S. Page, in which an enormous dose of powdered opium was taken by mistake for cubebs. The stomach was evacuated, and revulsive means employed, but the patient remained completely insensible. An electro-magnetic apparatus was then used, one pole being placed over the heart, and the other on a corresponding point of the right side. The patient opened his eyes, groaned, and moved his arms. After the fourth shock, he spoke, and did not become insensible again.⁵ Another instance is related by Mr. Corfe. A man had taken an ounce and a half of laudanum, and appeared to be only a corpse. After the stomach-pump and external irritants had been used in vain, recourse was had to the electro-magnetic battery, and afterwards to the Leyden jar. The patient recovered.⁶ Scholz has strongly recommended this agent in *asphyxia neonatorum*. He employs it alternately with the warm bath, &c., at intervals of three or four minutes, avoiding carefully to apply too high a power, and states that it is superior to all other agencies, and, indeed, that after its failure none other can succeed.⁷

¹ See, also, B. FRANK, Vierteljahrschrift für die prakt. Heilk., xvi. 53.

² Archives Générales, xii. 461.

³ Lancet, July, 1841, p. 661.

⁴ Lond. Med. Gaz., March, 1843, p. 925.

⁵ Am. Journ. of Med. Sci., April, 1843, p. 301.

⁶ Lancet, Jan. 27th, 1844.

⁷ MEYER, Die Electricität, &c., p. 146.

As early as 1809, Mr. Babington reported the ease of a person asphyxiated by charcoal fumes, but who was resuscitated by passing the charge from a galvanic apparatus through the chest.¹ Recently Mr. Farmer found that the shock of an electro-magnetic battery arrested suddenly the intoxicating effects of chloroform.² These cases show that various modes of employing the electric stimulus have been employed, and that no special direction of the current has appeared necessary; but, according to M. Duchenne, it should be transmitted through the phrenic nerves, so as to excite contractions of the diaphragm and cause the inspiration of air.

Indolent Ulcers.—Mr. Spencer Wells employed a single pair of galvanic plates (zinc and silver) to promote the cure of indolent ulcers. If the flabby granulations, or the inactive surface of the sore was to be destroyed, the zinc plate was applied to it, and the silver plate upon the moistened or blistered skin in the neighborhood. The subsequent process of cicatrization was promoted by reversing the position of the plates. A curious statement is made by this writer, that if the zinc plate is applied upon the *upper* portion only of a large ulcer, this portion alone improves, whereas, if it is applied to the *lower* portion only of the same ulcer, the whole sore improves in the same degree. When the silver plate is laid upon the opening of a fistulous sore, its effect does not extend beyond the edges of the ulcer, and in order to influence the interior a silver probe projecting from the plate must be introduced, when granulation from the bottom rapidly ensues.³

Aneurisms.—The power of galvanism to coagulate albuminous liquids leads to the suggestion that this agent might be employed to coagulate the blood in certain aneurismal tumors. Mr. Phillips appears to have been the first to experiment upon this idea in 1832, and his suggestion was carried into effect with variable success soon afterwards. In 1845–46, Pétrequin proposed the operation as original, and reported several cases of its success, particularly in superficial aneurisms by anastomosis.⁴ In 1853, a case of aneurism of the external iliac was cured by Mr. Eyre by means of galvano-puncture. The operation consisted in introducing into the tumor two long fine needles connected with the wires of a galvano-magnetic machine, and sustaining their action for twenty minutes. At first no immediate effect was produced, except pain and agitation of the whole body. Afterwards the tumor became painful, and the skin over it erysipelatous. The patient, however, escaped this peril, and, after some days,

¹ Med.-Chir. Trans., i. 83.

² Boston Med. and Surg. Journ., Feb. 1855, p. 19.

³ Times and Gazette, July, 1853, p. 84. ⁴ Revue Méd., vol. xcvii. xcvi. xcix.

the tumor began to diminish and harden, and finally became quite small, and free from aneurismal characters.¹ Some of these effects had already been described by Schuh.² This writer attributes the curative results partly to the inflammatory action induced, but states that coagulation within the sac takes place first and chiefly at the positive pole or needle. The first result of the operation is pain, followed on the next day by hardness, heat, and tenderness, which may continue for several days. The operation is not without danger, for when the veins are affected, phlebitis not infrequently ensues. Its success in the case of aneurisms of arterial trunks depends greatly on the current of the blood being retarded by the application of a bandage above and below the seat of the disease.

Galvanic Cautey.—If a platinum wire is brought to a white heat by galvanism, it may be used to cauterize or divide the living tissues. The earliest suggestion of this operation is contained in M. Becquerel's *Treatise on Electricity* (1836), where its use is ascribed to M. Fabre Palaprat. Cauterization of the dental nerves was employed by Heider, of Vienna, in 1845. About the same time, Crusell, of St. Petersburg, proposed the use of an incandescient wire as a substitute for the knife in surgical operations. In 1849 Sedillot cured an erectile tumor by the electric cautery. In 1850 Marshall, of London, made use of the same method to cure fistulæ, and from that date to 1853 various operations, analogous to those mentioned, were performed by Hilton and Ellis, of London, and by Nélaton, Leroy d'Etiolles, and Amussat, of Paris. In the following year Mitteldorpf (from whom these details are borrowed) published his essay on the Galvanic Cautey (*Galvano-Cautique*).³

The apparatus used for generating the galvanic current is that which Dr. Hare invented under the name of *Calorimotor*, and in which the surface of the plates is greater in proportion than their number. By its means loops of platinum wire, arranged variously according to the part to be attacked, are brought to a temperature at which the tissues can be divided or simply cauterized by the pressure of the incandescent metal. The advantages ascribed to this operation are the absence of hemorrhage when the wire is of sufficient thickness, the rapidity of its performance, the slight pain and extent of traumatic injury produced, the facility which it gives of cauterizing and cutting deep-seated parts, the production of healthy granulations, and its superior neatness and delicacy in comparison with ordinary methods of actual cautery.

¹ *Times and Gazette*, July, 1853, p. 95. ² *Zeitschrift der Wien. Aerzte*, 1850, 6.

³ *Archives Gén.*, Aug., Dec. 1855, pp. 145, 444, 706.

The affections to which it is adapted, and in most of which it has been used by Mitteldorpf, are these: *hemorrhage* from cavities and deep-seated parts inaccessible to ordinary instruments; *neuralgia*, by cauterizing the skin over painful portions of the nerve; *paralysis*, by the same operation near the nerves involved; *ulcers*, which require surgical treatment; *fistule, strictures of the urethra*; cancerous, vascular, and other *tumors*, on the external surface of the body, of the neck of the uterus, the vagina, rectum, &c.; excision of the *uvula* and *tonsils*, of polypi of the nostrils, throat, auditory canal, and even of the larynx; and, finally, *amputation* of fingers, the penis, the clitoris, and the testicle.

Electric Moxa.—Golding Bird proposed to use galvanism as a moxa, by applying a single pair of plates upon a blistered surface and connecting them with a wire. The skin under the zinc plate is cauterized within forty-eight hours, and an eschar separates in four or five days. Mr. Wells found that it is quite unnecessary to blister the surface on which the silver plate is applied, if it is only moistened with vinegar or other acid solution.

Of the other medical uses of galvanic and magnetic electricity the following may be mentioned. A young lady had run a cambric needle into her knee. Dr. Gill, of New York, whose assistance was requested, bound a horse-shoe magnet over the part so as to charge the needle by induction. Afterwards when a magnetic needle was brought near, its deviation and dip showed the position and direction of the needle in the flesh. Its north and south poles being marked, a line drawn between them represented the position of the lost needle. An incision was made accordingly, and the needle, so ingeniously discovered, was extracted.¹

In 1847 Dr. Dewees wrote that he believed he had succeeded, by means of galvanic plates, in extracting mercury from a patient who had been using this medicine.² Since then, and quite recently, Dr. Huff, of Lexington, Kentucky, and MM. Vergnies and Poey, of Paris, claimed to have removed mercury, and also lead, from the system by subjecting the patient to a galvanic current while he is isolated in an acidulated bath.³

It has also been proposed by Orioli, Harle, Prevost and Dumas, and others, to employ galvanism for procuring the disintegration of stone in the bladder. But no practical results of importance have yet been obtained.

¹ Am. Journ. of Med. Sci., Jan. 1847, p. 263.

² New York Journ., May 1847, p. 307.

³ Phil. Med. Exam., Aug. 1855, p. 507.

VINUM.—WINE.

HISTORY.—The earliest notices of wine are contained in the account of Noah's drunkenness (B. C. 2500), in the history of Lot's unnatural crime, and in the dying prophecy made by the patriarch Jacob (B. C. 1700).¹ Both in sacred and profane writings it is frequently associated with oil in the descriptions given of different countries, as emblems of their fertility and wealth. On the other hand, the books of Scripture, especially those of Solomon, abound in pictures of the calamities that attend the intemperate use of wine and strong drink. No modern experience or ingenuity has painted in darker colors or more hideous forms the consequences of intoxication. The Greeks and Romans employed wine both as a common drink and as a medicine. Among the former, the wines of Cyprus, Lesbos, and Chio, were much celebrated, and, as all readers of Horace will remember, the Chian wine was held in high esteem. The prevailing quality of this, as well as of the other wines just mentioned, was sweetness and a delicious flavor. The wines of Corcyra and of Mende were remarkable for their good qualities; those also of Naxos and Thasos, though generally considered inferior to Chian wines, were compared to nectar.² The ancients were extremely careful to adapt the quality of wine to the various conditions of the system. There is hardly any disease in which it was not used under one or another form, and the properties of each variety were carefully described by the medical writers of Greece and Rome. The tendency of new wine to derange the digestion, promote urination, and disturb the sleep; of must, or unfermented wine, to produce colic, flatulence, and diarrhoea; of sweet wine, as well as new, to impair digestion and produce headache;—these and many other qualities both good and evil were ascribed to different varieties of this intoxicating liquor. Galen, also, enumerates very fully the properties of a great number of Italian, Greek, and Asiatic wines, but he, like previous authors, dwells more upon their evil than their good effects when used habitually. Still earlier, indeed, Hippocrates had expressly referred to the muscular debility which results from the habit of indulging in wine. He also points out the dangers of abandoning it too suddenly.³ Among its medical uses, the writer last named refers to its efficacy in various cases of

¹ Genesis ix. 21; xix. 32; xlix. 11.

² MOREWOOD, *An Essay, &c., on Inebriating Liquors* (Lond. 1824), p. 20. Compare, also, PLINY, *Hist. Nat. lib. xiv.*, where the whole subject is treated of in detail.

³ STRUMPF, *Handbuch*, i. 951.

narcotic poisoning (by conium, opium, aconite, mushrooms, &c.), and describes it as an antidote to the bites of venomous serpents and insects. He directs it in the cold stage of fevers, to counteract hypercatharsis, and to relieve flatulence. He prescribes white wine as a diuretic in calculous affections, and directs pledgets of wool moistened with wine as an application to wounds and inflammations, and to phagedenic and other unhealthy sores. While admitting the diuretic and nervine qualities of old white wines, he does not fail to notice their tendency to produce headache. The medical uses of wine enumerated by Pliny are limited to certain symptoms rather than diseases; he mentions many conditions in which it is contraindicated, and very few in which it is beneficial. Of the latter, the *morbus cardiacorum*, supposed to be the sweating sickness, is one, and of it he says that the only hope of its cure is in wine.¹ Rhazes, among the Arabian authors, furnishes an ample account of this subject. Besides grape wine, he mentions that prepared from raisins, honey, dates, figs, sugar, barley, wheat, and the juice of sweet fruits, from the cocoa, pomegranate, &c., but speaks of them as being all more unwholesome than the first named. Of the advantages of wine used in moderation, he remarks that it improves the nutrition and the complexion, promotes the excretions, and particularly the urine, renders the sleep sound and refreshing, and quickens the mental faculties. But if the bounds of sobriety are often overstepped until the speech grows thick, the mind confused, and the gait staggering, the result is very mischievous—for the body becomes feverish and relaxed, and all the matters which ought to be excreted are retained. Wine ought not to be habitually drunken, but only at intervals of several days; and as for intoxication, its repetition brings on disease, headache, paralysis, shaking palsy, and acute affections. Inflammation of the viscera, and especially of the liver, ensues. Boils, abscesses, mental weakness, epilepsy, apoplexy, dulness of the senses, inflammation of the eyes, muscular debility, emaciation and inappetence, with asthma and palpitation of the heart. Rhazes recommends emetics as a remedy for the nausea and headache following a debauch, and advises rest with the use of acid syrups diluted with water or barley water. The more important consequences alluded to, he says, are to be cured by abstaining for a long time from wine, or, still better, by drinking no more of it one's whole life long.²

DESCRIPTION.—Wine is the fermented juice of the grape, the fruit

¹ Lib. xxii. cap. xxv. Ample accounts of the varieties of ancient wine and of their effects may also be found in DIOSCORIDES, lib. v. cap. vii.; and in ADAMS' Comment. on PAULUS ÆGINETA, i. 172.

² EBN BAITHAR, ed. Sontheimer, i. 386; ii. 548.

of *Vitis vinifera*. Of this plant several thousand varieties exist, which are distinguished by their foliage, or more particularly by the size, form, &c. of the clusters, and by the size, form, color, perfume, taste, consistence, &c. of the berries. The varieties appear to depend upon differences of climate, soil, and culture. In the wine-growing countries of the Eastern continent, the vine is cultivated in the open air. These countries chiefly lie between the latitudes of 25° and 52° N., extending from Shiraz, in Persia, to Coblenz on the Rhine. In the United States, the northern limit of the vine cultivated in the open air is not higher than 42° N., and Cincinnati, in lat. 39° N., is the only place where an extensive manufacture of wine has been carried on. Native varieties alone have thus far proved successful, and there is reason to believe that nothing but skill and perseverance are wanting to render this one of the wine-producing countries of the world, and by that means, more than any other, to diminish its national vice of intemperance.

The qualities of wine depend in a great degree upon the climate in which it is produced, and yet extremely slight differences of soil, or of exposure to the sun, occasion remarkable variations in the character of wines raised within a few hundred yards of one another.

The chief wine-producing countries are France, Germany, Portugal, Spain, Italy, the Canary Islands, and the Cape of Good Hope. The wines of France are popularly known in this country as claret and champagne, of Germany as *hock*, of Portugal as port, of Madeira, the Canaries, and the Cape of Good Hope as Madeira wine, and of Spain as sherry. More correct designations of the principal varieties are as follows:—

GERMAN WINES.—1. *Rhenish*. The best are white. The *Riesling* wines are distinguished for a singularly delicate, delicious, and refreshing flavor, and a peculiar bouquet. They are very highly prized in many nervous diseases. The *Orleans* wines are stronger, and without the aroma of the preceding. To these varieties belong Rüdheimer, Johannisberger, Hattenheimer, Marcobrunner, Steinberger, Hochheimer, Liebfrauenmilch, Niersteiner, &c. 2. *Main* wines. Of these the Steinwein is best known abroad. 3. *Pfälzer* (Palatinate) wines: Deidesheimer, &c. 4. *Moselle* wines: Brautenberg, &c. 5. *Aar* wines. 6. *Neckar* wines. 7. *Margrave* wines. 8. *Baden* wines. 9. *Bohemian* wines: Melnecker. 10. *Hungarian* wines: *white*—Oedenberger; *red*—Ofener, Erlauer, Tokay.¹

FRENCH WINES.—1. *Champagne* furnishes both white and red wines, the former of which are known everywhere, and are everywhere imi-

¹ STRUMPF, op. cit. i. 953.

tated, for their sparkling effervescence or their agreeable flavor. Of these the most celebrated brands are Sillery, Ay, Dizy, Epernay, &c. Of the red varieties the most approved are Verzy, Verzenay, Bouzy, St. Thierry, &c. 2. The wines of *Burgundy* are famous for their brilliant color, agreeable and delicate flavor, their agreeable perfume, and stimulating properties. The most celebrated vintages of red wine are Romanée Conti, Clos Vougeot, Chambertin, St. George's, Volnay, Pomard, and Beaune. Of the white varieties those best known are Chablis and Pouilly. 3. The *Bordeaux* red wines are celebrated for their marked but agreeable perfume and slight astringency. The finest are produced in the vineyards of Château-Lafitte, Château-Latour, Château-Margaux, Haut-Brion, St. Julien, St. Estephe, St. Emilion, La Rose, Leoville, &c. The best white *varieties* are Bommes, Rions, Grave, Sauterne, Barsac, &c. 4. The Hermitage in Dauphiny, the Côte Rotie in the Lyonnais, and in Languedoe the spirituous and cordial muscat wines of Frontignan and Lunel, are the most celebrated.¹

SPANISH WINES.—Malaga, Tinto de Rota, Alicante, Sherry, Tintilla, &c., which are all strong-bodied wines.

PORTUGUESE WINES.—*White*: Bucellas. *Red*: Port wine, &c.

ITALIAN WINES.—Albano, Monte Fiascone, Orvietto, Lachrymæ Christi, Alliatice, Marsala, &c.

AFRICAN WINES.—Madeira, Teneriffe, Constantia.

AMERICAN WINE.—Catawba.

The varieties of wine are so numerous that it is very difficult to classify them; but the following arrangement, based upon their chief constituent parts and the dependent effects, has been proposed by Mitscherlich,² and is perhaps the most satisfactory:—

1. Wines containing a large proportion of alcohol, and which produce the effects of alcohol in a marked degree: the spirituous wines.

2. Wines containing but little alcohol, with tannic acid and red coloring matter, which are less stimulant than tonic: the lighter red wines.

3. Wines containing little alcohol, but a large proportion of saline and acid ingredients, which, of all wines, are least excitant to the circulation, but readily derange the digestion: the lighter Rhenish and Moselle wines.

4. Wines containing little alcohol, but much carbonic acid, and which speedily develop the effects of these constituents: the sparkling wines—champagne, &c.

¹ CHEVALLIER, Dictionnaire, &c. des Substances Alimentaires, ii. 493.

² Lehrbuch, &c., ii. 316.

That such a classification is, however, extremely imperfect and insufficient, particularly in considering wine as a medicinal agent, is made apparent when we observe the wonderful variety of constituents which chemistry has discovered in the juice of the grape, as will be shown in a succeeding paragraph.

MANUFACTURE OF WINE.—The juice of the grape (*must*) is obtained by a wine-press, by various mechanical contrivances, or by simply treading the grapes with the feet covered with heavy wooden shoes. As soon as the expression is complete, the skins are mixed anew with the juice, and the whole is allowed to ferment. When active fermentation has ceased, which is known by the subsidence of the mass in the vat, by the cessation of the escape of carbonic acid, by the temperature of the liquid falling, &c., the latter is found to have lost its sweetness in great part, to have become clear, and acquired the vinous taste. It is then drawn off into casks, where it long continues to ferment, as the escape of froth from the bung-hole proves. As the liquid diminishes under this process, it is renewed by additional quantities. When all fermentation has ceased, the wine is kept perfectly at rest, in order to its becoming clarified by time and rest. During this period a deposit is formed (*lees*), which consists of bitartrate of potassa, coloring and vegetable matter, &c. After the lapse of five or six months, it is racked off into other casks, and this process is repeated every year, at the same period, until the wine is fit for use. In order to purify the wine, and free it from everything capable of injuring its qualities, it is subjected to *sulphuring*. This operation consists in burning one or more sulphur matches in the empty casks just previous to filling them with wine. It is believed to prevent its turning sour. The liquor is further purified, or *fined*, by the addition of isinglass, or white of egg, or the blood of an animal newly killed. The first forms with the tannic acid, and the others with the alcohol, reticulated coagula, which envelop and carry down the solid particles which endanger the safety of the wine. When completely clarified, the wine is preserved in casks, or still better in bottles. Some wines, as the Rhenish, may be preserved for an indefinite period; others but for a short time only. Pliny speaks of wines more than two hundred years old.¹

Constituents of Wine.—These are many and various, as, indeed, the sensible qualities of the liquor make manifest; but the following are discoverable by chemical analysis: Water; alcohol; extractive mucilaginous matter (*Chevallier*); carbonic, acetic, tannic, tartaric, and malic acids (free); bitartrate of potassa; tartrates of lime, alumina, and

¹ DIEU, *Mat. Med.*, iv. 234.

iron; chlorides of sodium, potassium, calcium, and magnesium; sulphates of potassa and lime; blue or yellow coloring matter; grape sugar; and œnanthic ether, with œnanthic acid, upon which the characteristic odor, or bouquet, of each wine depends.

Of the above elements the most important is alcohol, as upon its presence nearly all of the qualities depend which invite the use of wine. Its proportion varies, in the better sorts, between 7 and 26 per cent. The following tables may be considered as representing this proportion with some accuracy; but it is to be remembered that, apart from adulteration, natural causes produce great variation in this respect. The proportion, for instance, depends chiefly upon the quantity of sugar contained in the grapes from which the wine is made. Again, the age of wine, within certain limits, controls its alcoholic element, because every year adds something to the generation of alcohol from the decomposition of the saccharine element. On the other hand, it should not be forgotten that wine, in casks at least, must constantly part with a portion of its alcohol by evaporation. Christison is of opinion that it continually grows stronger until the conversion of its sugar is complete, after which its strength declines. Numerous analyses have been published showing the proportion of alcohol in different wines. The following are the most important:—

STRONG WINES.

	BRANDE.	CHRISTISON.
Marsala	25.09	
Port	22.96	16.20
Madeira	22.27	16.90
Cape Madeira	20.51	
Sherry	19.17	15.37
Teneriffe	19.79	13.84
Constantine (white)	19.75	
Lisbon	18.94	16.14
Malaga	18.94	

RHENISH WINES.

	GEIGER.		GEIGER.
Rüdesheimer	12.65	Steinberger	10.87
Geisenheimer	12.60	Leibfrauenmilch	10.62
Marcobrunner	11.60	Johannisberger (Prout)	8.01

FRENCH WINES.

	CHEVALLIER.		CHEVALLIER.
St. Georges's	15.00	St. Estéphe (red)	9.70
Barsac (white)	14.75	Château Latour	9.33
Champagne (still)	12.77	St. Emilion	9.18
Beaune (white)	12.20	Léoville	9.10
Champagne (sparkling)	11.77	Pouilly (white)	9.00
Hermitage (red)	11.33	Château Margaux	8.75
Volnay	11.00	Château Lafitte	8.70
Bordeaux (red)	10.10	Macon	7.66
		Chablis (white)	7.33

These results are presumed to have been obtained from pure specimens of the several wines, but cannot be assumed to apply to the liquors bearing their names which are found in commerce. This remark is true even of wine-producing countries, and consequently much more so of those to which the liquor is exported. Strumpf tells us that the difficulty of obtaining pure, unadulterated wine for domestic and even for medicinal purposes, is well known even in Germany, "for the wine trade is, with few exceptions, in the hands of avaricious usurers, knavish dealers, and greedy landlords, who have more regard for the gratification of their own avarice than for the health and lives of men. French, Spanish, and all other foreign wines seem, without exception, to be artificial rather than natural productions. Still worse, even German wines seldom form an exception to this statement, and it were easier to obtain pure musk or genuine cinchona bark, than faultless wine. Under such circumstances it is a precarious matter to attempt the cure of our patients with a liquid which really is almost never what it ought to be."¹ This complaint seems to be the very echo of that which was uttered by Pliny eighteen hundred years ago. Discussing the question which was the best wine, he exclaims, "but if all were agreed which is best, who could get it? Our very princes do not drink pure wine. To such a pitch has villany arrived that one can buy nothing more than the name of a vintage; from the very wine vat all of it is adulterated. And so, marvellous to tell, we may say of wine the poorer the purer."² It does not belong to our province to present details of the falsification of wines, but a simple enumeration of the substances employed for this purpose may not be uninteresting. Wines are diluted with water, and some specimens are fraudulent substitutions of cider or perry for the juice of the grape. Inferior qualities are made salable by the addition of a small proportion of a better description, and mixtures of various sorts ingeniously counterfeit the finer qualities; alcohol is added to thin wines, sour ones are sweetened with sugar, honey, or raisins, and pale ones are colored with burnt sugar. Acidulous wines have their acid neutralized by the alkalis, or by lime. Acetate of lead is sometimes fraudulently mixed with wines to give them a certain astringency, but more frequently is an accidental ingredient derived from shot used in cleansing the bottles, or by the liquor having passed through leaden pipes. Red wines are often manufactured out of alcoholic dilutions, colored by logwood, rhatany, beets, litmus, &c. &c. Astringency is given them by means of alum, oak or willow bark.

¹ Handbuch, i. 956.² Hist. Nat. xxiii. xx.

Action upon Man.—The action of wine is mainly stimulant. This property it derives chiefly from its alcoholic element, but in a degree which is far from being measured by the proportion of the latter, and it is further so completely modified by the other elements contained in the liquid, as to render the direct and still more the ulterior effects of wine widely different from those of ardent spirits. This peculiarity appears to be derived from the salts, acids, sugar, and ethereal elements in which it abounds, and which, while they moderate the stimulus produced by the alcohol, ensure a more rapid discharge than would otherwise occur of the latter substance. Hence it is incorrect to suppose that the alcohol contained in any given specimen of wine represents precisely its intoxicating power, or to assert, as some have unwisely done, that because a wine contains a certain percentage of alcohol, its effects upon the system will be identical with those which a like amount of alcohol diluted with water alone would produce. The stimulant effects of wine are experienced by the whole organism; the activity of the nervous system is quickened, the senses are all rendered more acute, the intellectual faculties acquire an unwonted rapidity and energy, the imagination is filled with a succession of pleasing or brilliant ideas, the affections are aroused to unaccustomed warmth, and, in particular, the amorous propensity is awakened. The pulse beats quicker, the cheek is flushed, and the eye is bright, the whole person seems expanded, the wrinkles of time and care are smoothed, and all the images of doubt and apprehension disappear. These effects are most strikingly produced by those of the sparkling wines, which contain a large proportion of carbonic acid, and but little saccharine matter. If the last-mentioned constituent is in excess, it tends to derange the digestion. The dry wines, on the contrary, such as Bordeaux and sound sherry, but particularly the former, tend but little to disorder the stomach, but are less exhilarating than the sparkling sorts.

The effects which have been described can hardly be considered as lying beyond physiological limits, unless by frequent repetition they induce a permanent derangement of the function either of digestion, innervation, or nutrition; but the following, which characterize a higher grade of intoxication, are essentially pathological. Under the influence of larger quantities of wine, or its more stimulant varieties, the genial and pleasurable excitement above described degenerates into a state bordering on delirium, which, according to the temperament of the individual, is gay or furious, incoherent, maudlin, or churlish. It is in this stage of intoxication that quarrels and combats take place, and crimes are committed which must be laid to the

account of intoxicating drinks, whether fermented or distilled. These phenomena of violent excitement are succeeded by symptoms which show the subsiding influence of the stimulant; the speech is no longer loud and clear, but thick, slow and incoherent, the head whirls, and all surrounding objects appear to move in a confused dance, the general sensibility is blunted, the hand seizes objects unsteadily and with an evidently impaired perception of their character, and, indeed, all the senses are more or less confused, the limbs bend under the weight of the body, and at last refuse to support it altogether. The curious remark has been made that those functions which habitual exercise has strengthened are generally the last to give way. The intellectual and educated man retains his reasoning powers long after his limbs refuse him the power of rising from the table; while the ignorant laborer will keep his feet and even carry burdens, when his mind is utterly bewildered and his speech quite lost.

When all the faculties are benumbed, and the muscles refuse to contract, there generally occurs derangement of the stomach, with violent and repeated and often prolonged vomiting, and not unfrequently the bowels and bladder at the same time are emptied of their contents; or, if these effects do not present themselves, the phenomena of narcotism supervene, with injected face, dilated pupils, a slow and full pulse, or else a small and frequent arterial beat, stertorous breathing, and a clammy noisome sweat over the whole body. This condition may pass into real and fatal apoplexy, or after a protracted sleep the drunken man may awake, but without any recollection whatever of the scenes of riot, or of brutality which he has enacted.¹

¹ The ancients have so well described the effects of wine as well as of intemperance in its use, that there needs no apology for citing a few examples:—

“How exceeding strong is wine! it causeth all men to err that drink it; it maketh the mind of the king and of the fatherless child to be all one; of the bondman and of the freeman, of the poor man and of the rich: it turneth also every thought into jollity and mirth, so that a man remembereth neither sorrow nor debt; and it maketh every heart rich, so that a man remembereth neither king nor governor. . . . And when they are in their cups they forget their love both to their friends and brethren, and a little after draw swords: But when they are from the wine, they remember not what they have done.”

I. Esdras iii. 18.

This passage and the following are from very different sources, yet they seem to be paraphrases the one of the other.

“Vina parant animos, faciuntque caloribus aptos.
Cura fugit, multo diluiturque:
Tunc veniunt risus, tunc pauper cornua sumit;
Tunc dolor et curæ, rugæque frontis abit.”

Ovid, *De Arte Amandi*, lib. i.

The reverse of this picture is sharply drawn by Lucretius, thus:—

“Denique cur, hominem cum vini vis penetravit

The habitual dietetic use of the lighter wines can hardly be considered injurious, since it is common to all sexes and ages in the vine-growing countries of Europe. But they are always diluted with water in proportion to the youth or the delicacy of constitution, and are very seldom taken in excess. "As a restorative, a means of refreshment where the powers of life are exhausted, of giving animation and energy where man has to struggle with days of sorrow, as a means of correction and compensation where misproportion occurs in nutrition, and the organism is deranged in its operations, and as a means of protection against transient organic disturbances, wine is surpassed by no product of nature or of art. The nobler wines of the Rhine, and many of those of Bordeaux, are distinguished above all others by producing the minimum of injurious after-effect. The quantity of wine consumed on the Rhine, by persons of all ages, without perceptible injury to their bodily health, is hardly credible. Gout and calculous diseases are nowhere more rare than in the district of the Rhinegau.

Aeris, et in venas discessit diditus ardor,
 Consequitur gravitas membrorum? præpediuntur
 Crura vacillanti? tardescit lingua? madet mens?
 Nant oculi? Clamor, singultus, jurgia, gliscunt?
 Et jam cætera de genere hoc quæcumque sequuntur?"

De Rerum Natura, iii. 475.

The consequences of confirmed inebriety are vividly described by Seneca. "Inde pallor, et nervorum vino madentium tremor, et miserabilior ex cruditatibus, quam ex fame macies; inde incerti labantium pedes, et semper qualis in ipsa ebrietate, titubatio; inde in totam eutem tumor admissus, distensusque venter, dum male assuescit plus capere, quam poterat; inde suffusio luridæ bilis et decolor vultus, tabesque in se putrescentium, et retorti digiti articulis obrigicentibus, nervorum sine sensu jacentium torpor, aut palpitatio sine intermissione vibrantium. Quid capitis vertigines dicam? Quid oculorum auriumque tormenta et cerebri æstuantis verminationes."—*Epistol.*, xciii. § 16.

The following verses of Obsopæus may serve as a pendant to the Roman picture:—

"Hæc est ebrietas, cultoribus ista rependit
 Dona suos; hosti vix satis apta dari.
 Ebrietas furiale malum, blandumque venenum,
 Mellitum exitium, dulcis amarities.
 Ebrietas vitium deformis; et fæda voluptas."

De Arte Bibendi (1536).

Matthiæolus, after extolling wine as the prince of all liquors, and indicating its precious uses in disease, says, "for all that, let no drunkard console himself, for, as all extremes are mischievous, so also is excess in drink." If in moderation, and judiciously given, it acts as a salutary stimulant, but when ingurgitated as it is by wine-bibbers, it extinguishes life, as too much wood puts out a fire. It is then the cause of "apoplexy, epilepsy, paralysis, trembling, vertigo, spasms, insanity, &c.," besides corrupting the whole life, rendering men quarrelsome, babbling, impudent, of unsound judgment, and addicted to gambling and debauchery, out of which come murders and homicides.—*Comment. in Dioscorid.*, v. vii.

In no part of Germany do the apothecaries' establishments bring so low a price as in the rich cities on the Rhine, for there wine is the universal medicine of the healthy as well as of the sick. It is considered as milk for the aged."¹ Still, it is generally recognized as true that children and females are better without wine, that it is very apt to develop adult functions and passions prematurely in the former, and to impair more or less the delicacy and freshness of complexion in the latter. It seems not improbable that the superior purity of complexion observed in English and American women as compared with those of continental Europe may be due in part to the abstinence of the former from all vinous and alcoholic drinks, especially in early life.

USES.—The remedial powers of wine depend almost exclusively upon its stimulant qualities, which it derives from alcohol; yet, as before remarked, its effects differ from those of distilled spirits, both by their less degree of intensity, and by the simultaneous operation of the other ingredients which modify the effect of the alcohol, and, to a certain extent, counteract its mischievous tendencies. In disease, however, wine is employed for the relief of the same essential conditions as distilled spirits, but usually of their milder grades, and when the susceptibility of the stomach or of the nervous system is readily offended by alcohol. The principal indications, or objects for which it may be used, are: to sustain or strengthen the enfeebled powers, and to regulate the disordered actions of the system. The following examples of its advantages will suffice to illustrate the general conditions for its employment.

Fevers.—In all forms of fever which assume the typhoid or adynamic type, and in which, generally, the constitution of the blood is more or less impaired, wine imparts an artificial strength, and sustains the organism against the destructive processes going on within it until these have exhausted their power. It perhaps also aids the system in throwing off morbid materials contained in the blood. Its virtues are most conspicuous in petechial typhus, the putrid malignant fever of Huxham, in which, says this author, "I cannot but recommend a generous red wine as a most noble, natural, sub-astringent cordial, and perhaps art can scarce supply a better."² Pringle speaks of giving half a pint of strong wine daily in such cases, or a quart of light French or Rhenish wine. Yet this is little, compared with what has sometimes been administered with palpable advantage. In one case, reported by Dr. Stokes, the patient in thirty-three days took about fourteen quarts of port wine. In another, two dozen of wine, besides six bottles of

¹ Letters on Chemistry, p. 454.

² An Essay on Fevers, p. 123.

brandy, were taken.¹ Dr. Chadwick says that in typhoid affections he has frequently exhibited a bottle of port or even a quart of brandy, in the course of twenty-four hours.² The symptoms which directly call for its use are prostration, petechiæ, stupor, brown tongue, feebleness and softness of the pulse, and particularly feebleness or absence of the impulse and first sound of the heart. The last symptom, which, when it exists, demonstrates more clearly than the rest the utter prostration of the vital powers, was first pointed out by Dr. Stokes as an indication for the use of wine in *typhus fever*, and its importance was confirmed by Graves.³ The latter states, as the signs of its usefulness, that the tongue becomes moister, the pulse and respiration slower, and the skin softer, while the restlessness subsides, and the impulse and first sound of the heart resume their proper force. Mr. Higginbottom, of Nottingham, England, a gentleman of large experience, asserts, on the other hand, that alcoholic stimulants are hurtful, and not useful, in typhus fever; but, as he couples this assertion, which he justly suspects may be considered "Utopian," with the rejection of alcoholic stimulants from the treatment of all diseases whatever, his judgment may be suspected of an unconscious bias.⁴ Dr. Wilks, of Guy's Hospital, has placed the subject on a ground more in harmony with general experience. He has shown that, although alcoholic stimuli cannot be viewed as essential to the cure of typhus, or as specifics for that disease, yet that success in its treatment depends in a great measure upon their proper management.⁵ The indications for their use have been pointed out above, and we need only add that to employ them before they are needed is to forfeit their advantages when they become essential to the cure. In *typhoid fever* the need of wine is generally less urgent, and, in fact, the use of evacuants is more commonly indicated. Still, in some cases, from an early period of the attack, and in others at a later stage, typhoid symptoms declare themselves, of which the most striking are dryness and a brownish coating of the tongue. Large quantities of wine are seldom called for, but weak wine-whey is frequently found of essential service, as, indeed, Huxham long ago taught in laying down the treatment of "a slow nervous fever."⁶

During *convalescence* from fevers, and all diseases in which the local lesion is either cured or is not in danger of being aggravated by stimuli, a moderate use of good wine with the food directly promotes

¹ Times and Gaz., May, 1854, p. 507.

² An Essay on the Use of Alcoholic Liquors, p. 122.

³ Clin. Med., p. 183.

⁴ Lancet, Aug. 1857, p. 166.

⁵ Guy's Hosp. Reports, 1855, vol. i.

⁶ Op. cit., p. 82.

its digestion in a high degree, and at the same time tends to inspire that genial sense of comfort which, indirectly, is one of the important conditions of recovery from disease, as it also is of the preservation of health. In many diseases the *debility* which results from copious and prolonged discharges—as of blood, pus, or mucus—from the lungs, bowels, uterus, vagina, or urethra, or from fistulæ, ulcers, or recent wounds, is diminished in a marked degree by wine, especially by the red wines of Bordeaux. In many, also, where, by reason of long repose or protracted pain, the strength declines, or the blood is impoverished, as in scurvy and chlorosis, or is probably impaired, as in atonic and irregular gout, the use of a moderate proportion of sound wine restores, more than any other single remedy, the tone and vigor of the system. It has even been remarked that strumous and other allied affections, occurring in the children of persons accustomed to a rich and stimulating diet, cannot be successfully treated without in some degree sustaining the action of the economy by means of a certain portion of wine taken with the food. Dr. Chadwick states, what general experience will doubtless confirm, that many cases of disease of the eye and of the scalp, in such children, can only be cured by wine and rich animal food.

In *syncope*, or rather when this condition is imminent, or the patient is reviving from its effects, the use of wine is general and even popular. Such states are met with after great hemorrhages, or other discharges, as the result, also, of severe pain, the shock of wounds and other injuries, of great alarm, of debility of the heart, &c. The remedy is not less appropriate in cases of great fatigue from application or anxiety of mind, and of exhaustion from prolonged distress; and some varieties of it, particularly the red Bordeaux wines, are capital stimulants of the digestion when this function languishes under any of the causes which have been enumerated. Aran¹ has recommended wine by enema as a tonic stimulant in cases of gastralgia in which the stomach refuses to bear the preparations of iron.

Wine is sometimes used with great advantage in *delirium tremens*, but is less commonly resorted to than brandy. The virtues of alcoholic remedies in this disease will be pointed out hereafter. In some of the minor *spasmodic* affections, and particularly in spasmodic vomiting, as that of pregnancy and sea-sickness, the sparkling wines taken cold are often of immediate and permanent utility. *Tetanus* has also been successfully treated with wine. Dr. Rush relates² that a quack in New England cured tetanus by giving *ardent spirits* in

¹ Bull. de Thérap., xlviii. 10 and 54.

² Works, i. 186.

such quantities as to produce intoxication, and Dr. Hosack records four cases of traumatic tetanus cured by wine in his own practice, and refers to another similar one reported by Dr. Wistar.¹ Currie, also, reports a case of the same disease which recovered after forty-two days of treatment, during which time one hundred and ten bottles of port-wine were administered.² He further describes an attack of tetanus in the horse, which was cured by the same means, "though not till the animal had drunk as much wine as he was worth."³ The ancients used wine as an antidote to narcotic poisons, and it has, likewise in later times been recommended in poisoning by mercury, arsenic, and cantharides. But modern experience has not lent its confirmation to such uses of wine. As an alcoholic stimulant, it may, however, be of use to counteract the depressing effects of hydrocyanic acid and of tobacco.

Red wines are also used as injections into the tunica vaginalis testis after the operation for hydrocele; into the urethra and vagina in chronic discharges from these passages, and into fistulous sores to mitigate their secretion. Jobert and L'Homme proposed injections into the peritoneal cavity after the operation of paracentesis in ascites, but their results are not adapted to encourage imitators.

ALCOHOL.—ALCOHOL.

HISTORY.—Long before it was known to the Western world, the art of distilling appears to have been practised in China, where it was applied to the production of alcohol from fermented rice.⁴ The earliest notice of alcohol by a modern writer appears to be that of Marcus Græcus, who is supposed to have lived in the latter half of the thirteenth century. This writer describes the distillation of alcohol (*aqua ardens*) from strong wines. About the same period Cardinal Vitalis de Furno eulogized this liquor as a panacea; Raymond Lulli (1315) styled it the supreme cordial of the human body, and Arnold of Villa Nova bestowed much pains upon perfecting it in the shape of spirituous drinks. In the latter half of the fourteenth century, its use was general as a cordial throughout Germany and Italy, although its mode of preparation was kept secret by the chemists. It bore various names, of which one of the most common was *vinum adustum*, in German *gebraunter Wein*, or *Brannt-Wein*, whence are derived the French *brandevin*, and the English *brandy*. In most languages, also, it bore a

¹ Essays, ii. 245.

² Med. Reports, i. 148.

³ Ibid., p. 150.

⁴ MOREWOOD, an Essay, &c., on the use of Inebriating Liquors.

title corresponding to the English "spirits of wine." The name of *alcohol*, which it received in the sixteenth century, is not, it would seem, of Arabian etymology. It was applied as a generic term to all bodies in a state of very minute subdivision, and hence to all refined and subtle products, such as the distilled spirit of wine. The art of extracting alcohol from wheat, barley, and other cereals was early discovered, as may be inferred from the fact that in 1595 the danger of perverting these productions from their natural uses was perceived and prohibited under heavy penalties. Very soon afterwards alcoholic preparations made from the juice of the sugar-cane, from molasses, the cocoa-nut, rice, &c., came into vogue, and in the eighteenth century various fruits, and, above all, potatoes were prostituted to the same purpose. In 1796, Lowitz and also Richter discovered the means of rendering alcohol absolutely pure, by depriving it of water by means of carbonate of potassa, and chloride of calcium.¹

PREPARATION.—"Alcohol is a product of vinous fermentation, which consists in the decomposition of grape or cane sugar into carbonic acid and alcohol. It is also generated when ether (oxide of ethyl), separated from its combinations, comes into contact with water." It is obtained in a diluted state (*ardent spirits*) by distillation from any liquid in which vinous fermentation has taken place, such as wine, beer, &c. In vine-growing countries, as France, it is extracted from wine, and is called *brandy* (*brandevin*); *whiskey* is yielded by a fermented infusion of wheat, rye, barley, or potatoes, and when rectified with turpentine is called common gin, and with juniper berries Holland gin; *rum* is obtained from the distillation of molasses; *ratafia* from sugar-cane juice; *arrack* from rice and the cocoa-nut; *kirschwasser* (cherry water) from crushed cherries; *slivovitz* (an alcoholic drink used by the people in Austria, Hungary, Bohemia, and Poland) from plums. These forms of ardent spirit contain different proportions of alcohol varying from 20 to 55 per cent. Brandy, rum, gin, and whiskey contain from 50 to 55 per cent. of pure alcohol, according to Brande. The peculiar taste of the several liquors is due to ænanthic ether, fusel oil, and various ethereal oils; in the case of gin, to the oil of juniper.

The *rectification* of ardent spirits consists in depriving them of their water and volatile oils, and their degree of purity is denoted by their specific gravity. When they have a sp. gr. of 0.920, they are termed proof spirit. This is, however, far from pure, but is further rectified by repeated distillation. The officinal alcohol of the U. S. Pharma-

¹ STRUMPF, Handbuch, i. 961.

copœia has a sp. gr. of 0.835. The specific gravity of absolute alcohol is 0.794.

Properties.—Alcohol is a limpid, colorless, volatile, and inflammable liquid, of an agreeable penetrating odor, and a peculiar burning taste. It has never been frozen. Dr. J. K. Mitchell, who, by the evaporation of solid carbonic acid and ether in vacuo produced the greatest cold ever attained, found that alcohol of sp. gr. 0.798 became oily and adhesive at -130° F.; by a greater degree of cold it became still thicker; and at -146° F. it flowed like melted wax. Alcohol of 0.820 froze easily.¹ Its boiling point is 172° F. The chemical formula for alcohol is $C_4H_5O + HO$. It has a strong affinity for water, and when mixed with it evolves heat. This peculiarity explains its action upon certain organic bodies. When immersed in alcohol they part with their water, and shrivel up. As it also excludes atmospheric oxygen, it hinders putrefaction. Hence its familiar employment to preserve anatomical specimens, fruits, &c. Where, however, it is desirable to retain unimpaired the color and shape of delicate parts, alcohol is objectionable on account of its corrugating the tissues, and coagulating albuminous products. On the other hand, it is a solvent of organic and vegetable alkalis, of urea, sugar, camphor, resins, balsams, volatile oils, castor oil, soap, &c.

ACTION. On Plants.—Alcohol speedily destroys the life of plants when their roots or stems are immersed in it. Its action upon them has been compared to that of hydrocyanic acid.

On Animals.—It is poisonous to all animals. According to Fontana, leeches wet with alcohol die in two or three minutes. When partially immersed in it, the part of the body which it touches is paralyzed. Forty drops of it given to a frog proved fatal in forty minutes, but when injected under the skin it killed in one minute. It is also fatal when applied to the brain or spinal marrow, after having induced paralysis. When the crural nerve of a frog is moistened with this liquid, the limb loses its power of motion; the same result, with depressed action of the heart, ensues, when the whole limb is wet with alcohol. Turtles speedily perish under the influence of alcohol, whether it be introduced into the stomach, or the bowels, or into the cellular tissue. The pulsations of the heart soon cease under its application, whether before or after its removal from the animal's body. Fish lose their activity in water containing but a small proportion of this liquid, and birds, according to Flourens, are deprived of sensation and voluntary motion by a few drops of brandy on the

¹ Boott, *Encyclopædia of Chemistry*, p. 85.

exposed brain, and have their equilibrium deranged when it is applied to the cerebellum.¹

Injected into the veins alcohol produces symptoms depending upon the quantity employed at any one moment, and the purity of the liquor. As early as 1679-93, Courten, Lanzoni, and Baglivi showed that highly rectified spirit might prove instantly fatal when employed in this manner, and that after death the blood was found coagulated in the heart, lungs, and other parts. Viborg injected two drachms of whiskey into the jugular vein of a horse, and produced all the phenomena of alcoholic stimulation. The animal became gay and warm, the eyes were prominent and bright, the ears moved to and fro, and the pulse was full and active. These phenomena continued for three quarters of an hour, but gradually diminished, and were followed by signs of depression and debility; but within four hours the condition of the animal appeared to be the same as before the experiment.² Segalas injected half an ounce of strong alcohol into the crural or jugular vein of a dog, and, like the earlier experimenters, produced instant death, with coagulation of the blood. When the same quantity, with four or five times its weight of water, was injected at once, complete intoxication followed, with loss of motion, insensibility, abdominal respiration, and a scarcely perceptible pulse; but when it was introduced gradually, in the course of an hour, the symptoms were slight and transient.³

Injected into the cellular tissue of a dog, to the amount of eight or ten drachms, Orfila⁴ found that the animal became agitated, walking about at random for thirty or forty minutes, but without appearing giddy; he then staggered and vomited bilious matters. Twenty minutes later, in spite of being very giddy, he ran wildly about, frequently falling. At last he lay motionless and insensible on his side, with limbs relaxed, and breathing deeply. In two or three hours more he died. On dissection of his body the only lesion discoverable was coagulation of the blood in the limb operated upon, and in the heart.

In the stomach of large rabbits an ounce of absolute alcohol produced the following results, according to the experiments of Mitscherlich. No excitement ensued, but great depression, and within from two to twelve minutes there was a complete loss of sensibility and muscular power, so that the strongest mechanical excitants scarcely induced the slightest movement; the breathing was hurried and the pulse very rapid; slight convulsions ensued of the feet and eyes, and

¹ WILMER, *Wirkung*, &c., i. 90.

² *Ibid.*

³ *Lancet*, 1839-40, ii. 443.

⁴ *Toxicologie*, 5ème éd., ii. 683.

⁵ *Lehrbuch*, ii. 329.

the pupils, at first contracted, became largely dilated, and death without convulsions took place in from one and a half to two hours. The body was immediately opened. The alcohol appeared to have exerted a chemical action upon the follicular and vascular structures of the stomach. The mucus upon its inner surface was coagulated, and in some places stained with blood. Where this had taken place the mucous coat was softened, but elsewhere was fragile and formed of corrugated cells, a result, perhaps, of the withdrawal of water from them by the action of the alcohol. The vascular and the cellular coats were thickened by an exudation, which in some cases was clear, and in others bloody. The odor of alcohol was quite perceptible in the peritoneal cavity, but not in the small intestine; the latter organ was but slightly affected, its epithelium being partly converted into mucus. Mitscherlich is of opinion that this alteration was due not to the direct chemical action of the alcohol, so much as to its constitutional irritation, and he compares it to the condition found where a lingering death has ensued upon excitement in other forms of poisoning. He found no peculiar alteration in any other organ. The brain was moderately congested; the blood was unchanged and did not emit an alcoholic odor. Jacobi and Falck performed a series of experiments with various mixtures of alcohol and water upon pigeons, rabbits, and dogs, and obtained results similar to those which have been above described.¹

The effects produced on dogs by *the long-continued use* of alcoholic liquors have been described by Huss, after experiments by Dahlström. Three dogs of different ages and dispositions were chosen, and during eight months there was administered to each of them a daily dose of six ounces of common (potato) brandy. The symptoms produced were alike in all, and may be thus summarily described. At first the animals did not exhibit any peculiar aversion to the liquor, but by the end of the first month they would not swallow it unless it was administered by force. During the first three months they displayed a peculiar liveliness which approached delirium (*Wildheit*), and a voracious appetite, after the alcohol had been given. They were also very thirsty. During the whole of this period they continued to be fat and in good condition. In the fourth month their bark began to grow hoarse and lose its clear tone; a harsh and dry hiccup and cough accompanied, the eyes were watery and staring, the sense of hearing less acute, the whole manner listless; the sleep was disturbed by spasms of the limbs, and the animals often uttered plaintive cries; they seemed averse

¹ Brit. and For. Med.-Chir. Rev., April, 1858, p. 530.

to making exertion, and preferred lying upon the side. After the fourth month they were tremulous while standing, and staggered when they were forced to stand. The limbs, especially the hinder ones, were evidently weak, so that the animals ate sitting. As they lay upon their side, twitchings were visible in the muscles of the trunk as well as of the limbs, and although their manner was generally indifferent, the sight of other dogs excited them to violent anger and furious attacks, in spite of their weakness. Gradually their strength declined more and more, and the cutaneous sensibility, particularly of the ears, diminished in a remarkable degree. The appetite was also impaired, and at last they showed a decided aversion to food, and could not be induced to devour raw meat. All this time their animosity for other dogs continued, and displayed itself even when they were no longer able to make an attack. None of the dogs lost flesh; on the contrary, they were fatter than at the beginning of the experiment. One of the three died at the expiration of eight months, with signs of complete exhaustion; the others were killed. Similar changes were found in the bodies of all the animals. The stomach was contracted, and its mucous membrane lead-colored and œdematous; the intestinal mucous membrane was unaltered, but covered with thick and fetid mucus. The liver was considerably enlarged, of diminished consistence and dark color; the bile also was dark, thick and stringy; the heart, spleen, and kidneys unchanged; the mucous membrane of the nose, trachea, and bronchia was slightly inflamed; the cerebral vessels were distended with blood; the muscles pale, flaccid, and atrophied, and the subcutaneous fat spongy.¹

The experiments of Duchek had essentially similar results, but showed the different influence on nutrition of the stronger and the weaker alcoholic preparations. To a dog two years old, rather thin, and of a small species, was daily given about half an ounce (15 grm.) of absolute alcohol, which was followed regularly by intoxication. Emaciation, and weakness in the hinder limbs, occurred. Death at length ensued, and the blood abounded in carbonates, and contained much sugar. To a large setter two or three spoonfuls of corn brandy were given daily for ninety-three days. Upon this he became very fat, and was quite well, when he was accidentally killed. The blood contained much sugar, but there was no other anatomical change.²

On Man.—Externally. When alcohol is applied to the skin in small quantities, and is allowed to evaporate, or if its evaporation is promoted

¹ Cronische Alkoholskrankheit, 1852, p. 517.

² Prager Vierteljahrschrift; and Philad. Med. Examiner, Feb. 1854.

by a current of air, it produces a sensation of cold. When it is rubbed upon the skin it excites warmth, and upon tender places a smarting or burning pain, and stimulates the functions of the skin itself, and of the organs immediately beneath it; but if its application is continued, it excites permanent redness, and even inflammation. If the skin be abraded and bleeding, it also produces severe smarting and a burning pain, which is, however, transient, and at the same time it coagulates the blood and arrests its flow. Similar sensations are produced by its application to mucous membranes, and a copious secretion of mucus and of the fluids from the adjacent glands may take place.

Internally. Alcoholic liquids, when taken pure and in small quantities, occasion a burning sensation in the throat, a feeling of warmth and constriction at the epigastrium, and the secretion of saliva, and of thickened and then watery mucus, in the mouth and throat. The sense of warmth diffuses itself from the stomach over the whole abdomen, or even the entire body, and is accompanied with an increased frequency of the pulse, and a disposition to perspire. In some, particularly females and nervous persons, these phenomena are attended with a little exhilaration; but in males, and those at all accustomed to alcoholic drinks, the mind is quite unaffected.

Larger, but still not excessive, quantities of alcoholic drinks have for their direct effect to quicken all the functions, to excite the pulse and animal heat, promote the flow of thoughts, and augment the muscular strength. The face becomes flushed, the eyes are brighter, and a feeling of increased power, both mental and physical, is experienced, accompanied with a disregard of obstacles in the way of accomplishing proposed objects, or a singular misconception of their magnitude. The modest man grows bold, the timid despises danger, the taciturn becomes garrulous, the imaginative enjoys a livelier flow of thought, and, in general, all of the faculties, both mental and moral, assume a more genial action. Sometimes, on the other hand, alcoholic drinks appear to sour or embitter the temper, and the unhappy victim of this peculiarity sits moodily aside, or scowls at the hilarity of his companions. Or, in other cases, they excite the most extravagant expressions of grief for trivial causes. But inordinate gaiety and exaggeration of ideas are more common effects.

The effects of intoxication by increasing doses of alcoholic stimulants have been thus graphically described:—

“With his progressive intoxication, an extreme loquacity hurries the individual along into every form of indiscretion, tears the veil of his character, and betrays him into intemperate attacks upon others, or into imprudent avowals with reference to his own thoughts and

actions. His imagination revels in unassociated and distorted images; his memory fails; his ideas elude him; and, while still speaking, he forgets the subject of his discourse, and maunders without judgment and without coherence. His virtues decline into defects; his courage becomes bravado, his liberality profusion, his friendship fawning. Meanwhile his physical agitation is in proportion to the disorder of his intellect. The face is flushed, the eyes flash, the brain throbs, and the action of the heart is inordinately excited. Extravagant gestures, reckless and inconsiderate actions, shouts, snatches of songs, and other tokens of frantic gayety, are alternated with complaints, expressions of resentment, and brawling anger, alike without definite aim or reason. He misapprehends what he hears and sees, and yields instantly to his own misapprehensions. His own voice, as well as that of others, sounds strangely in his ears: if he sings, the notes are false; if he speaks, it is with shrillness and elamor. As the intoxication advances, he is still restless in his movements, but they are wavering and without energy; and, as he totters from side to side, he sees objects double, or everything reels around him; or the level of the ground appears to rock beneath his feet, or rise before him to meet his steps. As a close, the speech falters; the indistinct words, the drivelling expression of ideas equally indistinct, linger half muttered on the lips; the features droop, and assume an expression of stolidity; the limbs cross each other, and at last sink powerless; and a benumbing torpor creeps over the senses, as, one by one, the nobler attributes of man's nature fall before the strength of the poison, and the power to consider and to judge lies as miserably extinguished as that to will and to act."¹

If the alcoholic drink is of the stronger sort, and has been imbibed in undiminished doses while the power of swallowing lasts, more serious symptoms still present themselves. The external signs of consciousness are but little, if at all, perceptible; the face is generally turgid and livid, or deadly pale and sunken; the pupils are contracted or widely dilated, the eyelids droop, and the eyeball is muddy and injected. Vomiting of food or viscid mucus sometimes follows, or an involuntary discharge of urine and fæces, with an apoplectic sleep and spasms of the muscles, and a small and frequent or slow and laboring pulse, with general insensibility even to the most painful irritants, coldness of the extremities, hurried, irregular, or stertorous breathing, and foam upon the lips. This state, after several hours' duration, may end in asphyxia or apoplexy, or may continue from one to three or four days before it terminates in death or in gradual recovery. If the subject of these frightful symptoms survives, he is affected with severe

¹ WILSON, *The Pathology of Drunkenness*, p. 26.

pain in the head, confusion of mind, or *mania à potû*; his strength is utterly prostrated, and he suffers from intolerable thirst. He has no appetite for food, and is unable to retain what he eats; his tongue is heavily coated, his breath heavy and fetid, his digestion almost suspended, and for many days he mopes listlessly, depressed in spirits, and unfit for labor.

When a large quantity of strong alcoholic drink is taken into the stomach at a draught, the symptoms at once produced are those of the highest grade of intoxication that has just been described. Death from this rapid saturation of the system with alcohol is by no means rare. Orfila mentions an instance in which a man died immediately from the effects of a large dose of brandy. Dr. Rösch relates three cases in which adults died from the immediate effects of excessive drinking in a few hours. Taylor says that a man died in half an hour after swallowing a bottle of gin for a wager. Rösch also relates the cases of two children in which quite a small quantity proved fatal,¹ and Dr. Seaverns one in which a child two years of age died in about twenty-four hours from drinking less than an ounce of New England rum.² The symptoms observed are insensibility, convulsions, stertorous breathing, sunken features, motionless pupils, a thready pulse, a moist cold skin, and death in a state of coma.

The *post-mortem* appearances in acute poisoning by alcohol are generally the following: The face is swollen or livid, the eyes prominent, the lips blue; the lungs filled with dark blood, as are also the heart, the liver and their large venous trunks. The odor of alcohol is perceived in the stomach and chest; the vessels of the brain are congested; there is not unfrequently an effusion of bloody serum under the membranes; and alcohol is alleged by Ogston, Perey, and others to have been found in the ventricles or in the substance of the brain.³ The stomach is reddened in patches, and there is acute œdema of the lungs.⁴

Effects of Habitual Intoxication.—These have long attracted the attention of physicians. More than sixty years ago they were so minutely and graphically described by Lettsom,⁵ that little has remained for later writers than to retouch and enlarge the picture. This has been skilfully done by Dr. Wilson in the work which has already been referred to. The health of the habitual drunkard may at first appear to be unaltered or but slightly impaired; he may even for some

¹ WHARTON and STILLE's Med. Jurisprudence, § 734.

² Bost. Med. and Surg. Journ., March, 1857, p. 99.

³ An Experimental Inquiry concerning the presence of Alcohol in the Ventricles of the Brain. By JOHN PERCY, M. D., Lond. 1839.

⁴ WHARTON and STILLE, op. cit., § 737.

⁵ Memoirs of Med. Soc. Lond., i. 151, &c.

time present the aspect of more than ordinary robustness in his full rounded form and florid complexion. But his complexion exhibits occasionally a peculiar pallor, interlaced with small, red streaks, or else a faint tinge of purple. The figure, although round, has a bloated look instead of seeming firm and elastic; the cheeks are flabby, the eyes blood-shot, and the tip of the nose displays a crimson hue. Slight exertions occasion hurried breathing and speedily induce fatigue. The digestion now begins to fail; the meals are taken with less regularity and with diminished zest, or the palate craves the excitement of salted, highly spiced, or acidulated food. A feeling of nervous exhaustion is experienced on rising in the morning, together with mental depression and trembling of the hands, and these symptoms become almost intolerable until the stimulant which is to allay them can be procured; and they are, besides, renewed as often as the impression of the remedy subsides, to be relieved again and again by a repetition of the same dangerous cordial. In many cases the quantity imbibed is every day increased, until the stomach revolts against the imposition, and, by rejecting the liquid, forces to a suspension of its use. But the nervous system, no longer sustained by its habitual stimulus, falls into disorder, the muscles all are seized with trembling, the senses convey false impressions to the mind, and the reason itself is reduced to a state of imbecility. Phantasms surround the patient; insects float through the air or creep upon the walls of his chamber or upon his person, or, if he is left alone, particularly in the dark, he is haunted by visions more horrible than the sound imagination could conceive. He seems to be in a waking nightmare, in which ghastly and terrible figures of men and animals assault or career around him, or seem upon the point of seizing and destroying him. He may be seen crouching in a corner and covering his eyes in a vain attempt to shut out the phantoms, or rushing wildly around, bathed in sweat, as he endeavors to elude his tormentors; or he lies in bed shuddering and almost paralyzed with terror, his eyes starting from their sockets, and his dishevelled hair on end.

If these attacks are frequently repeated, and the habit that induces them is not suspended, the whole constitution gradually becomes impaired. Sound sleep is completely at an end, and the hours of rest are rather filled with terror than repose. Even by day the sensibility is so perverted as to occasion a variety of distressing illusions. The energy, both of mind and body, gradually declines, the latter in consequence of the wasting of the muscles, which is seen in the shrunken body, the attenuated limbs, and the general air of decrepitude which not unfrequently accompanies the still bloated and coarsely featured face. Fothergill describes a peculiar condition occurring in an ad-

vanced stage of habitual drunkenness: The lower extremities, he says, grow more and more emaciated, the legs become as smooth as polished ivory, and the soles of the feet glassy and even shining, and at the same time so tender that the weight of the finger excites shrieks and moaning, and yet I have known that, in a moment's time, heavy pressure has given no uncasiness. The legs and arms become paralyzed, and thus for years the patients may exist without material change.¹ The same disease was more recently described by Dr. James Jackson, of Boston, evidently without a knowledge of his having been anticipated. Dr. Jackson denominates it *arthrodynia-à-potû*, and the essential correspondence of his own with the earlier description proves the exactness of both.² Not the least remarkable feature of the drunkard's history is the benumbing effect which his vice exerts upon his moral sense. All delicacy, courtesy, and self-respect are gone; the sense of justice and of right is faint or quite extinct; there is no vice into which the victim of drunkenness does not easily slide, and no crime from which he can be expected to refrain. Between this condition and insanity there is but a single step. Sometimes that step leads at once to drivelling imbecility, in other cases illusions, such as those which characterize delirium tremens, become fixed and permanent; or mania results from the hideous character of these illusions, and sometimes displays itself in a homicidal or an incendiary form.³

With these, or analogous evidences of the constitution's decay, the digestive function is seriously impaired; a constant waterbrash is present, or is most distressing in the morning; the food is rejected soon after being swallowed, or gives rise to the most distressing heartburn and oppression; the tongue is fissured, rough, flabby, and tremulous; "the breath smells like rotten apples" (*Lettsom*); the bowels are irregular, and often the seat of colic, and hæmorrhoids are of frequent occurrence; the liver becomes cirrhotic,⁴ ascites follows as a consequence

¹ Mem. Med. Soc. Lond., i. 159.

² New England Journ. of Med. (Oct. 1822), xi. 351.

³ Mr. Winslow stated, some years ago, that out of 495 insane persons in the Liverpool Asylum, 257 owed their insanity to drunkenness. In the Richmond Hospital, Dublin, out of 286 cases, 185 arose from drunkenness. (*Lancet*, 1839-40, i. 545.) In the Glasgow Lunatic Asylum, the proportion during six years may be stated at one-fifth from this cause. In England, nine provincial private asylums furnish a proportion of insane cases from this cause of 36.62. (*Carpenter*, Prize Essay, Am. ed., p. 47.) Dr. Howe alleges that, of 300 idiots in the State of Massachusetts, whose history he investigated, the immense proportion of 145 were the offspring of intemperate parents.

⁴ The remarkable influence exerted by reducing the allowance of alcoholic drinks in diminishing the occurrence of liver-complaints in India is shown by the history of the Cameronian regiment in Bengal. The mean of three years, in which a large quantity of spirits was used, was 128 cases, while in two years of temperance, the mean number of cases was 66, or about one-half. (*Lancet*, 1840-41, ii. 557.)

of this lesion, and thus the tumid belly and the shrunken limbs form a contrast which is one of the most striking phenomena of this disease. At the same time the skin grows dingy, the eye jaundiced, watery, and bloodshot; sharp neuralgic or rheumatic pains rack the limbs, and sometimes a morbidly acute sensibility affects the latter, and the feet especially. In some cases the extremities lose all power of action, and even their sensibility, the palsy extending from the periphery to the centre, and occasionally a like paralysis affects the bladder, the rectum, or the œsophagus.¹ "Thus universally assaulted, without rest and without support, and alas! without sympathy, nature yields up the conflict. The senses and the intellect glide into utter imbecility, which expresses itself in vacant mumblings; and death, in a worldly sense a deliverance, terminates the miserable scene, the craving for spirits having not rarely subsisted to the close. One by one the lights have been removed from the banquet of folly, and the last is now extinguished." (*Wilson*.)

It would not be consistent with the objects of this work to present a more detailed account of the manifold evils inflicted upon the health by an abuse of spirituous liquors. It is believed, however, that none of importance has passed without notice. But in order to complete the picture it is necessary to describe, with such brevity as the case permits, those structural alterations which the habit of alcohol intoxication induces.

Lesions produced by Chronic Alcoholic Poisoning.—Kubick describes the *blood* of drunkards, when drawn from a vein, as furnishing a small and soft clot, with a yellowish-green surface, the serum as turbid, yellowish-green and opaline; and the clots in the large veins as dark, soft, and incomplete. Schultz supposes that the usually dark color of the blood favors the supposition of its having undergone some special change, which, however, he does not admit to be an excess in the proportion of its hydrogen and carbon.² He also performed upon animals some experiments, intended to elucidate this question, but, as they consisted of injecting alcohol into the veins, they cannot be regarded as illustrative of the action of alcohol taken into the stomach, and as an habitual drink. According to Huss, the blood frequently has a milky aspect which he ascribes, in common with several other writers, to an excess of fatty matter.

The *stomach* is generally much smaller than natural,³ and is often affected with thickening of its muscular coat; its mucous membrane is seldom sound, but of a slate color or still darker, studded with

¹ Huss, *op. cit.*, p. 383.

² Monthly Journ. of Med. Sci., Oct. 1841.

³ OGDON, Br. and For. Med.-Chir. Rev., July, 1855, p. 192.

enlarged mucous follicles (mammillated), and covered with a thick coating of tough mucus. The mucous coat is likewise thickened, and not unfrequently the seat of ulcerations. The *small intestine*, sometimes, but not frequently, presents similar alterations.

The *liver* is the seat of very characteristic alterations; that is to say, it most frequently presents the several stages of the so-called "fatty liver." This is generally accompanied by a great increase in its size. Cases have been reported in which it weighed eighteen, twenty, thirty, and even forty pounds. In some instances the organ is contracted, hardened, and nodulated, in one word "cirrhotic," or presents the appearance of yellow wax. This change appears to be the consequence of the adhesive inflammation, or at least the obliteration, of the portal veins, and is most frequently attended with abdominal dropsy.

The *kidneys* are frequently, but by no means uniformly, the seat of granular degeneration (Bright's disease). In such cases, too, it seems probable that this disease is not so much a direct result of the action of alcohol as of other causes, such as cold, which act upon the kidneys all the more easily in consequence of the state of erethism in which they are kept by stimulating drinks.

Adipose matter is generally very abundant in the bodies of drunkards, both in the subcutaneous cellular tissues, and around the heart and kidneys, and in the omentum. In the last situation it has been described as "ashy-gray and slushy."¹

In other organs than those mentioned, and particularly in the *heart* and *brain*, lesions are occasionally found which writers have attributed to slow poisoning by alcohol; such, in the former, are valvular diseases, hypertrophy, and atrophy; and in the latter, dilatation of the bloodvessels. But these alterations of structure occur with too little regularity in drunkards to warrant our regarding them as effects of their vicious habits.

Modus Operandi.—Alcohol is absorbed with great rapidity by the veins of the stomach and intestines, and may be traced in the blood, the bile, and the urine. It has, however, been rarely detected in the last named section, and the fact itself might still be questioned were it not that Dr. Percy extracted from the urine of an habitual drunkard a liquid which had all the aspect of alcohol, and burned with a blue flame.² It is possible that the result of this experimenter is exceptional, since Bouehardat and Sandras assert positively that alcohol is

¹ N. Y. Journ. of Med., iii. 336.

² Monthly Journ. of Med. Sci. (1841), i. 739.

eliminated by none of the excretory organs, and that a small portion only is exhaled from the lungs.¹ According to the authors just named, it is speedily converted by the inspired oxygen into water and carbonic acid, or else into acetic acid. Some writers have asserted that alcohol has also been found in the ventricles of the brain. Thus Ogston states that, in one case, nearly four ounces of fluid were found in the ventricles, "having all the physical qualities of alcohol,"² but, as nothing is said of its inflammability, it may be presumed that in this instance, as in most others, the odor of fusel oil was relied upon to prove the presence of alcohol itself. That alcohol has been found in the brain, that is to say, in the bloodvessels of this organ, as it has been in other parts of the circulatory system, has been supposed to be unquestionable. A striking example of the apparent presence of this liquid in the blood is mentioned by Dr. Mussey.³ A medical friend of his bled a man who had been drinking freely for three or four days. The halitus of the blood burned for thirty seconds, with a blue flame, on the application of a lighted taper. Yet it is maintained by recent observers⁴ that alcohol, as such, cannot be detected in the blood; and that only aldehyde, a product of its decomposition, is to be discovered in that fluid.

The phenomena attending the so-called "spontaneous combustion" of drunkards prove how thoroughly the body may become saturated with alcohol or its immediate products. It may be remarked of these cases that the subjects of them all were persons addicted to the abuse of spirituous liquors, that they were generally corpulent, and that the combustion of their bodies has been nearly total, while the adjacent objects were slightly or not at all injured. The examples of this curious mode of death are too numerous and well authenticated to permit any doubt as to their reality; but they were, in fact, examples of "increased combustibility of the human body," due to its saturation by alcohol.⁵

The universal addiction to alcoholic drinks could not exist without some good reason; this fact alone demands that we endeavor to ascertain what is real and what is illusory in the sentiment of the whole human race concerning them. On the one hand, it is certain that alcohol is a poison, and that consequently in employing it we make use of what

¹ *Annuaire de Thérapeutique* (1847), p. 279.

² *Edinb. Med. and Surg. Journ.* (1833), xl. 293.

³ *Trans. Amer. Med. Assoc.*, viii. 575.

⁴ DUCHEK, *Prager Vierteljahrs*, 1853, and *Phil. Med. Exam.*, Feb. 1854, p. 90.

⁵ For examples the reader is referred to WHARTON and STILLÉ's *Medical Jurisprudence*, part ii. chap. viii., and WILSON's *Pathology of Drunkenness*, p. 92 and seq.

is, *under certain conditions*, destructive of life. But, as in the case of all other "poisons," it is their dose and not their nature which renders them mischievous. Examples have been cited of the superior exemption of disease among troops and other bodies of men who abstain from alcoholic stimulants, and which contrast agreeably with the deplorable results of indulgence in their use by men under similar circumstances. Of the latter, the most striking and painful illustrations have been given, and particularly by British troops in the East and West Indies. After twenty years' service in India, Annesley declared that the habit of dram-drinking destroys more lives in that country than the climate or the sword. Similar testimony might readily be obtained from all who have occupied the same or a similar field of observation. Mr. Marshall long ago proved that in India, at least, ardent spirits neither contribute to enable men to undergo great fatigue, nor protect them against the fevers endemic to that region.¹ In a very different climate, that of Holland, the experiment was made of giving spirit rations to four regiments, and withholding them from three selected for the purpose. In the former case the sick in two of the regiments amounted to 1 in 44; in the third to 1 in 29; and in the fourth to 1 in 46: while in the latter, the proportion of sick in the first regiment was 1 in 116; in the second, 1 in 60; and in the third, 1 in 158.² In this and all similar cases, those who partook of alcoholic drinks did so to excess, and converted a nutriment into a poison. This was notoriously and flagrantly the case among the East Indian troops. It has generally been supposed that such drinks enable men to endure greater fatigue and perform severer tasks, but ample experience of the contrary abounds, whether we seek for illustrations among the icy regions that surround the northern pole, among the snowy peaks of Alpine regions, within the torrid zone, or, even in the temperate climates, where the use of such stimulants is most common. But it is to be observed that this remark applies only to prolonged, continuous, or habitual exertion. That the temporary stimulus of alcohol enables men to exert muscular energies far beyond their habitual power, cannot be questioned, nor on the other hand that, more than anything else, it repairs the exhaustion of fatigue, and reanimates the body about to perish from cold. No one, that we know, has successfully controverted these propositions. It is, indeed, true that some estimable promoters of a cause intrinsically good, but sadly injured by its too zealous advocates, have gone so far as to assert that "alcohol is a temporary excitant of the nerves, causing, like friction, or other mechanical

¹ Edinb. Med. and Surg. Journ., xli. 19.

² Bull. de Thérap., xxxiv. 456.

irritation, a *sensation* of warmth, or glow," while they deny that it furnishes the material for the evolution of caloric.¹ On the contrary, the whole tendency of observation and experiment is to show that this latter is precisely its office. As long ago as 1813, Dr. Prout proved that alcohol in every state and in every quantity uniformly lessens, in a greater or less degree, the quantity of carbonic acid contained in the expired air, according to the quantity and circumstances in which it is taken.² And quite recently Dr. N. S. Davis, of Chicago, proved that in two hours after a dose of alcohol, the diminution of carbonic acid amounted sometimes to fifty per cent.³ It offers itself in the place of the tissues to the oxygen which would else feed upon them, and thereby retards their waste, while, by the combustion of its elements with this same oxygen, it becomes a source of heat. The careful experiments of Böcker lead to the conclusion that it diminishes the waste of all the tissues whose products are secreted as component parts of the urine, the perspiration, or the feces.⁴ So, too, Liebig declares "that by the use of alcohol a limit must rapidly be put to the change of matter in certain parts of the body. The oxygen of the arterial blood, which, in the absence of alcohol, would have combined with the matter of the tissues, now combines with the elements of alcohol. The arterial blood becomes venous, without the substance of the muscles having taken any share in the transformation."⁵ This statement explains the notorious fact that they who drink alcoholic liquids with their meals, consume a proportionately smaller amount of food. Dr. Hammond, Surgeon of the U. S. Army, has contributed the results of some very carefully conducted experiments to the elucidation of this subject. His conclusions are these: "Under the use of alcohol the carbonic acid and aqueous vapor given off in respiration are lessened in quantity: The amount of feces is diminished; the quantity of urine is reduced, and its urea, chlorine, phosphoric and sulphuric acids are diminished in amount."⁶ In order to sustain this doctrine of the usefulness, within due limits, of alcoholic drinks, I shall, at the risk of repetition and of taxing the reader's patience, request his attention to the following assertion of its truth, by the late Professor Johnston. He says it is ascertained of ardent spirits—

"1. That they directly warm the body, and, by the changes they undergo in the blood, supply a portion of that carbonic acid and watery vapor which, as a necessity of life, are constantly being given

¹ Trans. of Amer. Med. Assoc., viii. 577.

² Lancet, 1842-43, ii. 17.

³ Trans. of Amer. Med. Assoc., viii. 577.

⁴ Beiträge zur Heilkunde, i. 247.

⁵ Animal Chemistry (Philad. ed.), p. 71.

⁶ Am. Journ. of Med. Sci., Oct. 1856, p. 305.

off by the lungs. They so far, therefore, supply the place of food—of the fat and starch, for example—which we usually eat. Hence a schnapps in Germany, with a slice of lean dried meat, make a mixture like that of starch and gluten in our bread, which is capable of feeding the body. So we either add sugar to milk, or take spirits along with it (old man's milk), for the purpose of adjusting the proportions of the ingredients more suitably to the constitution, or the circumstances in which it is to be consumed.

"2. That they diminish the absolute amount of matter usually given off by the lungs and the kidneys. They thus lessen, as tea and coffee do, the natural waste of the fat and tissues, and they necessarily diminish in an equal degree the quantity of ordinary food which is necessary to keep up the weight of the body. In other words, they have the property of making a given weight of food go further in sustaining the strength and bulk of the body. And, in addition to the saving of material thus effected, they ease and lighten the labor of the digestive organs, which, when the stomach is weak, is often a most valuable result."¹

USES.—The special medical uses of alcoholic liquors are so familiar, or so readily inferable from its dietetic employment, that little more than a bare enumeration of them is here required. Dr. Clutterbuck² expresses what we believe to be a demonstrable truth, that a moderate indulgence in the pleasures of the table conduces both to the attainment of vigorous health and to the prevention of disease. This we hold to be as undeniable as that excess in the use of alcoholic drinks, like gluttony or voracity, entails the ruin both of body and mind. Yet we do not advocate their habitual use, lest, their cordial effects being lost by custom, a temptation should arise to increase their dose beyond the bounds of prudence or safety. Apart even from this danger, there is every reason to think that the habitual employment of any quantity of spirituous liquor is rather mischievous than beneficial; in which respect it differs altogether from wine. It is barely possible, as regards the finer qualities of brandy, that a small portion may be taken daily with the food, for an indefinite period, without injury. Thus, there are thousands of French, both male and female, who, for the latter half of a long lifetime at least, are in the habit of using the *chasse café*—*i. e.* a very small glass of pure brandy—after coffee at the conclusion of dinner.

It must never be forgotten that in civilized life there is a comparatively small number of persons in whom the functions are performed

¹ The Chemistry of Common Life (Am. ed.), i. 288.

² Lancet, 1841–42, ii. 97.

with perfect exactness and regularity. Our whole system of preparing food is a standing confession of our feeble digestion; there is not a condiment, a sauee, or a change in the mode of cooking, that is not an evidence of our artificial condition. The refinements of modern society have prolonged the average duration of life, but, by so doing, have increased the number of those who require artificial stimulants, if not for their support, at least for their extrication from dangers frequently brought upon them by their constitutional debility. Or, even if the wear and tear of using it have not endangered the integrity of the economy previously to middle life, there generally comes a time when the functions fail, and the roundness of the form is succeeded by the rugged outlines of wasted muscles, because the digestive organs are no longer able, as they formerly were, to convert food into flesh. At this period the genial stimulus of alcoholic drinks arouses the stomach, and gives it a vigor which it in turn imparts to every other portion of the economy.

But, as a *medicine*, alcohol, in the form of distilled liquors, is frequently required to relieve *temporary debility* of the system. This is strikingly the case after grave accidents, particularly where the tissues are crushed, and also during severe surgical operations; under such circumstances these liquors eminently deserve the name of *cordials*, and prevent that sinking of the courage which may end in fatal syncope. When the subjects of such accidents or operations are of intemperate habits, they are very apt, within from twenty-four to forty-eight hours, or later, to be attacked with delirium tremens, unless a full supply of alcoholic stimulants is afforded. Under such circumstances, also, the administration of these remedies quickens the processes which are necessary to a cure. It has been found, for example, that the production of callus upon a fractured limb has been very imperfect, or even failed altogether, until the system felt the stimulus of alcoholic drinks. In like manner a tendency to *syncope* from other causes may be suspended by these stimuli. Every one is familiar with the powerful effect they produce in diminishing the sense of *fatigue* produced by prolonged muscular efforts. There seems to be no doubt that this property causes them to be sought for with so much avidity, and used to such excess, by people of the laboring classes.

It is unnecessary to repeat in this place what has already been said (see *Wine*) regarding the use of diffusible stimulants in *typhus fever*, and in typhoid affections generally, although very similar remarks might be made. In general, and for continued use, wine is greatly preferable to brandy; but in the lower forms of adynamia the temporary employment at least of the latter article is essential. When, too,

the patient, as often happens in hospital practice, is accustomed to its use, it may be freely administered in the form of brandy punch. Dr. Todd¹ has reported eighteen cases of typhus fever, the treatment of which consisted in administering, either every half hour or every hour, day and night, from half an ounce to an ounce of brandy, with a draught, every second hour, containing ten minims of chloric ether and five grains of carbonate of ammonia. Under this treatment the pulse, within four days, fell from about 120 to about 90. This recent confirmation of the efficacy of the plan so warmly advocated by Drs. Graves and Stokes, and in this country pursued so successfully in ship fever and other forms of petechial typhus, deserves especial notice. A very eligible mode of administering brandy in such affections is milk punch, in which the relative proportions of the stimulant and of the nutritive element can be varied according to the predominance of typhoid symptoms on the one hand, or of simple debility on the other. A mixture intended to fulfil similar indications is the *Potus analepticus* of Hufeland, which consists of the yolks of two eggs, an ounce of sugar, two ounces of brandy, two pints of water, and half a drachm of powdered nutmeg. Similar remarks would be applicable to those forms of *erysipelas* which tend to phlegmon, in carbuncle, and in moist gangrene.

In not a few instances of *chronic fluxes* of the mucous membranes, and particularly of the intestine, the well-guarded use of alcoholic drinks is often of essential service. These are cases occurring in persons of relaxed fibre, of a lymphatic temperament, or in whom protracted suffering and evacuations have exhausted the recuperative powers of nature. Here the best remedy of the stimulant class is good brandy, to the extent of from half an ounce to an ounce daily, beaten up with the white or yolk of egg and powdered sugar.

In *delirium tremens* brandy acts as a specific cure. The earliest notice we have found of its use in this disease is by Dr. Hausbrandt,² who employed it successfully in the case of a drunkard in whom the attack came on several weeks after his commitment to prison for theft. In this country it appears that it was occasionally used by New England practitioners in the treatment of this disease. But the first systematic demonstration of its superiority over other modes of treatment was given by Dr. Gerhard, of Philadelphia, who had a large field for the observation of its results in the Blockley Hospital, to which he was attached. He there showed that by substituting the alcoholic for

¹ Times and Gazette, Aug. 1853, p. 217.

² Rust's Magazine, 1826; and Journ. des Progrès, i. 268.

the opiate treatment the mortality of the patients was reduced from ten to less than one *per cent.* In slight cases he prescribed an ounce of brandy every three or four hours; or, if the tremors were severe, the double of this dose. When patients had been used to inordinate quantities of alcoholic drink, still larger doses were administered, as two ounces every two hours; but this amount was not continued for more than a single day, as a general rule.¹ Mr. Solly confirms this statement of the value which we attach to the method in question. He says: "The plan of treatment which I have found, on the whole, most successful in true delirium tremens, is to give the stimulus which the patient prefers, from being most accustomed to."² In mild cases, we are of opinion that porter is preferable to distilled liquors, on account of the narcotic and tonic elements which it contains; but in severe ones the stronger preparations of alcohol are alone effectual. It has been objected to this method that it tends to foster the vice of intemperance. Whether or not the alternative proposition of leaving drunkards to die is more consonant with charity and duty, is a question which we leave the casuists to decide.

Alcohol may be used as an antidote to *narcotic poisoning*, by opium, digitalis, tobacco, &c., although there are few toxicological writers who allude to this employment of the remedy, which is of common use by Italian practitioners. There would seem to be some reason for believing that it is really indicated in the state of depression produced by these agents. The power it has of neutralizing the effects of tobacco fumes is familiar to all smokers; and a case is on record in which a patient appears to have been snatched from profound narcotism by the administration of brandy.³ The same remedy has sometimes been found effectual as an antidote to the poison of *venomous serpents*. Cases of the sort have been published by Ramsey and by Mayrant, in which large doses of brandy saved the patient's life.⁴ Dr. Gilman, of St. Louis, asserts that alcohol, if brought in contact with the venom, is, to a certain extent, an antidote;⁵ but Breschet and Pravaz state that the poison, preserved in alcohol, loses none of its deleterious qualities.⁶

In *traumatic tetanus* the curative effects of wine have been already noticed. In one of the cases of cure reported by Mr. Curling in his work on tetanus, brandy and porter were used, besides large quantities

¹ Library of Pract. Med. (Am. ed.), ii. 245.

² The Human Brain (Am. ed.) p. 280.

³ SHEPARD, in Medical Repository, iv. 347.

⁴ American Medical Recorder, vi. 619.

⁵ Charleston Journ., ix. 510.

⁶ Annales de Thérap., ii. 273.

of wine. A similar result was obtained by Mr. Stapleton with large doses of alcohol,¹ and by Mr. Ilott with wine and brandy as the chief remedies.²

The *vomiting of pregnancy* is said by Pigeaux generally to yield to the administration of a small glass of brandy taken at meals which, he recommends, should consist of substantial food.³

In two cases of *general dropsy*, occurring in drunkards, and following their abstinence from stimulating drinks, Brierre de Boismont found a cure in the use of alcoholic liquors. In one of these cases delirium tremens and dementia, and in the other acute mania, preceded the appearance of the dropsical effusion.⁴

Externally, alcohol and its preparations are employed as styptics, astringents, and stimulants. From its power of coagulating the blood, diluted alcohol has sometimes been found serviceable as a *vaginal injection* in cases of *passive hemorrhage* from the womb. It is a popular and useful application to all recent *excoriations*, *bruises*, and *sprains*; it forms the best lotion for parts of the *skin* subjected to *pressure in bed* during long confinement by surgical injuries, or by fevers of a typhoid type. *Ulcers* resulting from pressure directly, or with the intervention of gangrene, and those of an equally atonic character produced by frost-bite, are generally improved by poultices containing alcohol; in this case, however, the fermenting poultice made with porter is to be preferred. Brandy is used with great advantage to prevent *fissure of the nipples* after childbirth, in women who are subject to this accident. In the latter case it should be applied daily for some time before confinement, and rendered more efficient by the addition of a small proportion of alum or tannin. It is very useful as a preventive of *excoriation of the feet* by walking, and also to relieve their soreness after prolonged exercise. During recovery from paralysis its use in frictions of the *palsied limbs* tends to hasten the development of the muscles.

Superficial and recent inflammations of all kinds are frequently cured by weak lotions of brandy, or alcohol and water. Thus, a mixture of one part of brandy with fifteen or twenty of water has been found effectual in arresting slight attacks of *acute conjunctivitis* when applied in the forming stage. Compresses, wet with diluted alcohol, form an agreeable dressing for recent and superficial *burns*, in consequence of the cold produced by the evaporation of the liquid. For the same reason similar dressings are of use in all other cases of super-

¹ Lancet, March, 1845, p. 317.

² Ibid., May, 1845, p. 648.

³ Bull. de Thérap., iii. 134.

⁴ Annuaire de Thérap., 1845, p. 101.

ficial inflammation, and are peculiarly so when it is desired to moderate vascular action in the head in *cerebral inflammation*, *fevers*, *head-ache*, &c. On the other hand, the irritant action of the remedy may be had recourse to in the treatment of chronic *urethral discharges*, to induce adhesive inflammation in the tunica vaginalis testis after the operation for *hydrocele*, &c. In like manner the inhalation of alcoholic vapors has been employed to cure *chronic bronchitis*.

ANTIDOTES.—The best remedy for alcoholic intoxication is vomiting. This, indeed, often forms the natural cure. Its operation is not confined to voiding the stomach of its poisonous contents. This effect is certainly the most important when a short time only has elapsed since the liquor was swallowed; but after the complete absorption of the poison, and even after its secondary effects are developed in the form of mania, or delirium, this remedy continues to be the most effectual. It produces relaxation, while it more than anything else soothes the nervous agitation, and disposes to sleep. When the symptoms are those of profound intoxication, when the patient is not only “dead drunk,” but utterly insensible, with dilated pupils, and turgid or else sunken features, he is, of course, unable to swallow, and generally the stomach-pump must be used. Afterwards, an emetic of *mustard* should be given by the same instrument, if the patient is still insensible. This is more effectual than sulphate of copper, or sulphate of zinc; and tartar emetic is on no account to be employed. In milder cases *ipccacuanha* is admissible. At the same time the head should be elevated, all pressure removed from the neck, and cold applications, particularly a stream of cold water, directed upon the head. Blood-letting is very rarely admissible, and is, perhaps, never advisable. Dry cups to the temples and nucha may, however, be directed. When once the threatening symptoms have passed away, the patient should be allowed to rest, for sleep will complete the cure. Milder forms of alcoholic intoxication are more speedily relieved by the preparations of ammonia, than by any other means. We have repeatedly known a person, who was lying apparently quite unconscious and insensible, rise and walk away after the administration of ten or twelve drops of the water of ammonia. The fumes of this preparation alone often have a very rapid effect. The acetate, the carbonate, and also the aromatic spirit of ammonia are said to be equally efficacious. Acids, such as vinegar, and lemon-juice, and also saline substances, such as smoked beef, olives, &c., are reputed to be capable of diminishing the effects of alcohol.

OLEUM TEREBINTHINÆ.—OIL OF TURPENTINE.

DESCRIPTION.—Oil, or as it is most commonly called, *spirits* of turpentine, is an essential oil procured by distilling the sap of certain coniferous plants, and in this country particularly *Pinus palustris* and *P. taeda*. It is chiefly produced in North Carolina.

Oil of turpentine is a colorless liquid of a peculiar odor, and a burning, pungent, and unpleasant taste. Its sp. gr. is 0.86, and its boiling point about 314° F. It is very slightly soluble in water, but readily dissolves in ether. Boiling alcohol takes up a certain proportion of the oil, most of which, however, it deposits upon cooling. One hundred parts of alcohol of sp. gr. 0.84 dissolve thirteen or fourteen parts of this oil, and absolute alcohol a still larger quantity. By exposure to the atmosphere it becomes oxydized, and, owing to the formation of resin, becomes thicker and also yellowish.

HISTORY.—In the Hippocratic writings, young pine shoots or cones are recommended in amenorrhœa, and in various uterine affections. Pliny describes several varieties of turpentine, and speaks of their use for coughs and ulcerated bowels; their resins he mentions as suitable to promote the healing of sores, and as ingredients of ointments intended to give suppleness and strength to the limbs.¹ He, and also Celsus, refer to their diuretic properties. Similar statements are made by Dioscorides.² In the sixteenth century Fernel described the properties of turpentine as follows: "Terebinthina calefacit, mollit, discutit, tergit, expurgat: viscerum omnium, maximeque renum, obstructions tollit, et angustos meatus aperit, urinam ciet, putredinem cohibet."³

The earliest reference which we find to the *oil* of turpentine is that made by Pomet (1692), who states that it is procured by distillation in the neighborhood of Marseilles and Bordeaux, and styles it a truly natural balsam proper for all kinds of fresh wounds.⁴ Its use as an internal remedy did not become general until the last century, when it was recommended by Boerhaave and others for chronic affections of the lungs and bowels, and various other diseases in which it was also customary to prescribe turpentine itself. These, as we find them stated by Hoffmann,⁵ were gonorrhœa, leucorrhœa, and calculous, gouty, and rheumatic affections. It was also employed as a purge, as a diuretic, and as a vulnerary. The author just mentioned refers to the use of the

¹ Hist. Nat., xxiv. 22.² Mat. Med., lib. i. ch. 76, 77.³ Opera, i. 441.⁴ Hist. des Drogues, p. 287.⁵ Oper. Omnia, Suppl., i. 744.

essential oil of turpentine as a medicine to be used with extreme caution, on account of its heating and irritating properties.

ACTION. *On Animals.*—Hertwig injected a drachm of oil of turpentine into the veins of a horse. Immediately the heart's action became irregular, and then ceased to be felt; the breathing was hurried and labored; the nasal mucous membrane was red and dry, and the breath of the animal smelled strongly of the oil. He had, besides, a vacant and dull look, and urinated frequently; but he soon recovered. In an experiment of Schubarth, two drachms of the oil were given to a dog, destroying its life in three minutes, with signs of great suffering.¹ In small doses the oil appears to excite the appetite and increase the secretions of the liver, bowels, and kidneys. Somewhat larger doses occasion colic, diarrhoea, hurried breathing, and arterial excitement, with an increased secretion of urine, which is sometimes tinged with blood. Mitscherlich's experiments showed that an ounce of the oil would destroy a large rabbit within forty-four hours, and half an ounce in sixty hours. The odor of turpentine was detected in the breath, and, after death, in the peritoneal cavity. The direct symptoms produced were great restlessness, frequent pulse, and hurried breathing, which lasted for two hours, and were followed by a copious secretion of urine exhaling the characteristic violet odor, and also by diarrhoea. The animals then appeared to be exhausted, and died without convulsions. No inflammation of the stomach or intestine was found. In the former organ were observed numerous flattened particles of blood as large as a pin's head or a flaxseed. They had stained the mucus of a brown color. The other organs were not materially changed.² Hertwig found that the oil, when rubbed upon the shaven skin of a horse, imparted its characteristic smell to the breath, and increased the discharge of urine. When applied to a wound or to the denuded cutis, it occasioned signs of pain followed by inflammation.

On Man.—If the back of the hand be kept moistened with oil of turpentine, a pricking sensation is experienced in about five minutes, and, in ten minutes more, a burning pain with moderate redness of the skin. If the application be continued for half an hour, the pain is very severe, and sometimes vesication follows. When terebinthinate vapors are *inhaled*, the specific effects of the medicine are produced. This is observed in the case of sailors on board of vessels laden with spirits of turpentine, or of persons employed to unload them, particularly during warm weather; in that of operatives in

¹ WILMER, *Wirkung*, &c., iv. 212.

² *Lehrbuch*, ii. 253.

manufactories of India-rubber where *camphene* (purified oil of tar) is used as the solvent of this substance, &c. Such persons are very apt, particularly at first, to suffer from nausea, vertigo, impaired vision, pain in the back and loins, strangury, bloody urine, insomnia, malaise, and an eczematous eruption. The females, in addition, are often affected with menorrhagia or dysmenorrhœa.¹ Bouchardat describes his having experienced similar symptoms in consequence of exposure to the vapors of turpentine.² In the case of a young lady reported by Favrot, the symptoms resembled those of the stage of collapse in cholera, except that there was no diarrhœa.³ The following are the phenomena produced by oil of turpentine when taken into the stomach, as described by Dr. Copland. This physician took ten drachms of the oil in coffee, and upon an empty stomach. His pulse rose from 69 to 80, and he experienced slight vertigo and chilliness, with heat in the stomach. After an hour, the vertigo and chilliness became greater, the countenance was pale and sunken, there was some confusion of mind, with increased gastric warmth and a sense of constriction of the bowels. The thirst and appetite were increased. The urine was more abundant and had an odor of violets, and for twenty-four hours the breath smelled of turpentine. The bowels were not moved.⁴ According to the same authority, when the dose is large and is given during a febrile disorder, it reduces the frequency and strength of the heart's action. Hence he considers that it should tend, as in fact it appears to do, to diminish the effusion of coagulable lymph, in inflammatory disorders.⁵ According to Dr. Thomas Smith, it sometimes produces copious diaphoresis with an itching eruption of the skin.⁶

It is believed that there is but one well authenticated case on record of death occasioned by the oil of turpentine. It is reported by Dr. Maund.⁷ A female of intemperate habits swallowed an unknown quantity of oil of turpentine, which may have amounted to six ounces. She was found dead, her body in a state of opisthotonos, and very rigid. The eyes were open and the pupils dilated. The brain, lungs, stomach, and both sides of the heart were gorged with dark blood, and six drachms of the oil were obtained from the stomach. In other cases, alarming symptoms have sometimes been observed. One

¹ MATTHEWS, Am. Med. Recorder, xiv. 75; E. HARRIS, N. Y. Journ. of Med., N. S. x. 38. For its action on the nervous system, see HOPPE, Journ. f. Pharm., i. 105, 157.

² Annuaire de Thér., 1846, p. 66.

³ Edinb. Med. Journ., iii. 1144.

⁴ Lond. Med. and Phys. Journ., xlv. 107.

⁵ Dict. of Pract. Med. (Am. ed.), ii. 81.

⁶ A Practical Treatise on the Therapeutic Uses of Terebinthinate Medicines, London, 1850.

⁷ Glasgow Med. Journal, Apr. 1857.

is on record in which two drachms of the oil brought on strangury, bloody urine, then its total suppression, with fever, violent thirst, and vomiting.¹ Dr. Smith, above referred to, relates that half an ounce, given to a boy sixteen years of age, produced a tendency to somnolency and profuse diuresis, and his breath smelled of the medicine for upwards of a week. The following case is related by Dr. Harris. A boy of three years old drank nearly *six ounces* of camphene. Within an hour and a half afterwards he was in a state of profound coma, the eyes suffused and injected, the pupils dilated, the pulse 130, the skin dry and hot, the mouth and fauces red and parched, the features somewhat contracted and anxious, and the respiration hurried. The abdominal muscles were very tensely contracted, as he lay curved, with his arms closely folded and pressed on his abdomen. . . . The child could not be kept awake, even while vomiting. There was constant priapism, with frequent attempts at micturition; but only four ounces of urine, and that bloody, were passed during eighteen hours, for which time the coma continued. For several days the patient remained excessively nervous and irritable, but at the end of a week he appeared to be well.² A case in which the symptoms closely resembled these, and which also occurred in this country, is quoted by Dr. Taylor.³ In it the quantity swallowed was four ounces, and the patient was an infant of *fourteen months*, yet recovered. A curious statement is made by Roche on the authority of Thénard. A lad was nearly asphyxiated by the air of a cellar in which turpentine was stored. On analysis of this air, it was found to be nearly deprived of its oxygen.⁴

USES. *In Hemorrhage*.—John Hunter is one of the oldest as well as the weightiest authority upon this point. He says: "I have seen it immediately stop vomiting of blood from the stomach after all other means had failed, given internally with the white of egg as often as the stomach would bear it. In external hemorrhages, where it had not the desired effect applied externally, I would give it internally. It is the best, if not the only, true styptic. Thus, in a case of nasal hemorrhage which nothing would stop, I gave ten drops of oil of turpentine in a draught, and repeated it every two or three hours, which entirely stopped the bleeding and it never returned."⁵ Adair relates a case of its arresting hemorrhage from the bowels;⁶ and Matthews, of Philadelphia, two similar cases.⁷ Percy used it successfully in various forms of passive hemorrhage, and particularly hæmaturia and intes-

¹ Edinb. Med. Essays and Obs., 2d ed., ii. 43.

² N. Y. Journ. of Med., N. S., x. 40.

⁴ Br. and For. Med.-Chir. Rev., Oct. 1856, p. 529.

⁶ Med. Facts and Obs., iv. 25.

³ On Poisons (Am. ed.), p. 426.

⁵ Works (Am. ed.), i. 304.

⁷ Am. Med. Recorder, xiv. 75.

tinal hemorrhage in typhoid fever. Its action he found to be less marked in organic affections of the womb and lungs, as well as in ordinary menorrhagia.¹ Mr. Vincent, of Dublin, found it efficient in the hemorrhagic diathesis, both when given internally and when applied as a styptic.² The remedy is undoubtedly most efficient in bleeding from the bowels and urinary passages, and from the external surface of the body, because, probably, it here comes into most immediate contact with the affected part. Yet there can be no doubt that it exerts a real influence even upon those hemorrhages less directly exposed to its operation. Thus, in addition to the illustrations already cited, Dr. W. Budd speaks of its great use in severe menorrhagia, and refers to a series of cases published by Mr. Griffiths, from which it would appear that, in the dose of from half an ounce to an ounce, this oil often succeeds in arresting hemorrhage after parturition.³ As regards the latter cases, it may be surmised that the remedy acted by exciting uterine contractions, as it is known to do, as well as by its styptic powers. Dr. T. Smith, of Cheltenham, also lauds its powers in all forms of internal hemorrhage; but, as he apparently associates with it other remedies of still more obvious efficacy, his eulogy can hardly be accepted without reserve.⁴

In *purpura hemorrhagica* the curative powers of this remedy are often decided. Thus, as early as 1821, Nicholl reported several cases cured by it;⁵ Magee, also, a case of cure, in which the patient, a child of only six years, took every day, for four days in succession, half an ounce of oil of turpentine, with an equal quantity of castor oil.⁶ Dr. W. Budd refers to an aggravated case in a female sixty years old, in whom the application of the oil arrested the bleeding from sloughing ulcers of the mouth, and the administration of ten minims of it every six hours was followed by immediate amendment.⁷

Puerperal Fever.—Oil of turpentine appears to have been first recommended for this disease by Brennan, of Dublin, in 1814. He administered it in tablespoonful doses, and applied it as an epithem to the abdomen. He attributed the happiest results to its use.⁸ Dr. Kinglake ascribed its success, which appeared unquestionable, to the large doses of it exhibited.⁹ Dr. Atkinson also published a favorable account of its effects.¹⁰ Dr. Payne, of Nottingham, describing a case of

¹ Am. Journ. of Med. Sci., Oct. 1848, p. 446.

² RANKING'S Abstract (Am. ed.), vii. 118.

³ Med. Times, Aug. 1850; and Am. Journ. of Med. Sci., Oct. 1850, p. 473.

⁴ Lond. Journ., Apr. 1850; and BRAITHWAITE'S Retrospect (Am. ed.), xxi. 416.

⁵ Edinb. Med. and Surg. Journ., xviii. 541.

⁶ Ibid., xxiv. 307.

⁷ Loc. sup. cit.

⁸ Lond. Med. and Phys. Journ., xxxii. 403. ⁹ Ibid., xxxiii. 181. ¹⁰ Ibid., p. 447.

the disease, says: "Although the patient was in *articulo mortis* at the time of the exhibition of the turpentine, she recovered very quickly; and the same success has attended the treatment with turpentine of every case of puerperal fever that has, within the last seven or eight years, fallen under my care."¹ Dr. Douglas, of Dublin, regarded it "as more effectually remedial than any other medicine yet proposed," and averred that under its use he had seen women recover after every hope of recovery, under ordinary treatment, had been relinquished.² Dr. Kinneir, without thinking that in the early stage of a majority of instances it ought to supersede the lancet, yet regarded it as a medicine of singular efficacy in this disease. He strongly advised fomenting the abdomen with the tepid oil, and he states that the patients expressed in the most forcible terms the extraordinary and almost instantaneous diminution of pain they experienced from its application.³ Dr. Johnson, of Charleston, S. C., has reported four instances of the cure of "puerperal fever," in which two drachms of this medicine, with an equal quantity of castor oil, were given every hour until free evacuation of the bowels took place.⁴ About the same time, a case, with a similar result, was reported by Dr. Lucas, of Madison, Ga.⁵ Rauch, of Berlin, has also published one in which the medicine appears to have arrested and cured the disease after the failure of the antiphlogistic method.⁶

Such numerous and varied authorities would perhaps have better established the efficiency of oil of turpentine as a remedy for childbed fever, had it been certain that they all referred to the same disease. Of this the proof is by no means clear. Some cases were evidently examples of that blood-fever which is, *par excellence*, the puerperal fever; others were perhaps cases of peritonitis; and others, again, instances of that mere tympanitic distension of the bowels which is independent both of inflammation and of pyæmia, but which is not unfrequently treated as if it were one of these. The small credit which the terebinthinate method now enjoys can only be accounted for by supposing it to have been found unsuccessful; for, in a disease which usually destroys one-third of all that it attacks, a really efficacious method would not have been allowed to fall into neglect. The more eminent accoucheurs express no faith in its efficacy, or else accord to it but little more than a negative value. Thus, Blundell does not think that it aggravates the symptoms, and Dr. Meigs finds no objections to its use, "seeing

¹ Edinb. Med. and Surg. Journ., xviii. 539; and *ibid.*, xxii. 53.

² Dublin Hosp. Rep., 1822.

³ Lond. Med. and Phys. Journ., liv. 33.

⁴ N. Am. Med. and Surg. Journ., vii. 306.

⁵ Am. Med. Recorder, vi. 615.

⁶ Archives Gén., 2ème sér., xiii. 105.

that the inconveniences of the practice are null, and that certain persons do appear to have been rescued by it from dangerous extremity."¹

Yellow Fever.—The styptic and stimulant properties of oil of turpentine led probably to its use in yellow fever, first, to arrest the gastric hemorrhage, and then to give the system energy sufficient to carry it safely through the disease. It was first used by Dr. Physick, of Philadelphia, in 1798. He discovered, says Rush, that ten drops of the spirit of turpentine given every two hours effectually checked the vomiting, in several instances, in patients who afterwards recovered.² It was also used by Drs. Chapman, Hewson, Jackson, and others, of the same city, during the epidemic of 1820, and in the same year by Drs. Waring and Kollock of Savannah, but in all of these cases without decidedly favorable results. Meanwhile it appears to have been employed in 1817, by Dr. Copland, during the prevalence of the disease on board a ship in which he was a passenger from Sierra Leone to Cape Coast Castle,³ and was subsequently recommended by him in his Dictionary of Practical Medicine,⁴ where he speaks of it as certainly beneficial when given during the stage of excitement as a purge, conjoined with other oils, and also during the stage of exhaustion as a styptic and stimulant in smaller and more frequent doses. In a letter addressed to him by Dr. A. Smith, a practitioner of Peru, the turpentine treatment is spoken of as "signally successful" among the Indians suffering from yellow fever.⁵ The remedy has also been used by Dr. Gilbert King, of Bermuda, and Mr. Laird, R. N., first with a view of restraining passive hemorrhage, and afterwards as a general stimulant, and for promoting the secretions of the skin and kidneys. Mr. Laird states that whereas the rate of mortality in 164 cases treated without turpentine was 1 in 6.6, it was only 1 in 8.6 of the same number to whom this medicine was administered.⁶

Typhoid Fever.—In 1826, Dr. Wood, of Philadelphia, originally drew attention to the use of spirits of turpentine in "a particular condition of fevers,"⁷ marked, during the decline of the attack, with sudden dryness of the tongue, tenderness and slight distension of the abdomen, a frequent and feeble pulse, wandering intellect, and an anxious suffering expression of countenance. Under the use of ten or fifteen drops of oil of turpentine, frequently repeated, these symptoms, which other stimulants were found to aggravate, began rapidly to decline, and convalescence shortly ensued. Dr. Wood's subsequent

¹ On Childbed Fevers, p. 321.

² Works, iv. 96.

³ Times and Gazette, May, 1855, p. 472.

⁴ Amer. ed., iii. 209.

⁵ Times and Gaz., loc. sup. cit.

⁶ Lancet, Aug. 1853, p. 183; Times and Gaz., Apr. 1855, p. 358, Jan. 1856, p. 45.

⁷ N. Amer. Med. and Surg. Journ., i. 272.

experience,¹ and, we may add, that of other physicians, tended to confirm the original conviction, that the medicine is effectual as a remedy for the conditions of typhoid fever above described. Its mode of action appears to be, locally, that of a healthful excitant of the intestinal ulcers, promoting their cure; and at the same time that of a genial stimulant of the whole economy.

In certain *intestinal fluxes* it has been recommended by Chapman, and particularly in *dysentery* "when gangrene is menaced," and in *cholera infantum* at a stage somewhat earlier; in *chronic diarrhœa*, he adds, with such discharges as denote the mucous coat of the intestines to be chiefly affected, "it is an incomparable remedy."² On the other hand, according to Kinglake, Vogt, and Paris, it is equally efficient in *obstinate constipation* attended with tympanitis, vomiting, and pain. In such cases it should be given in the dose of half an ounce with an ounce of castor oil. In flatulent distension of the bowels, and particularly of the colon, no other remedy is so effectual, whether it is administered by the mouth or by the rectum. In the latter case an enema may be used consisting of from half an ounce to an ounce of the oil mixed with flaxseed tea or other similar excipient.

Intestinal Worms.—This oil has long been one of the most efficient among vermifuge medicines. Long since Malden,³ and afterwards Fenwick,⁴ reported its success in England, against tænia, and in this country Dr. Heyward published a case of cure in 1819.⁵ But not to dwell on particular instances, reference may be made to the summary of experience on the subject furnished by Bayle,⁶ from which it appears that out of eighty-nine cases reported by various authors, seventy-seven were cured, eight were improved, and in four only was the remedy inefficient. Large doses of the oil were generally given, that is to say, from half an ounce to two or three ounces. In most cases the worm was discharged dead. It has also been successfully used for the destruction of *lumbrici* and *ascarides*.⁷ Dr. Klapp, of Philadelphia, found it very effectual in destroying worms in the stomach, and removing symptoms attributed to them, even when none of their remains could be detected in the evacuations. He directed it to be given in doses of from six to twelve drops three times a day.⁸

Biliary Concretions.—The use of oil of turpentine in cases of this affection was first proposed by Vallisneri, and afterwards, in 1782, by

¹ Practice of Medicine, 4th ed., i. 346.

² Therapeutics, ii. 89.

³ Mem. of Med. Soc. London (1795), iv. 419.

⁴ Med.-Chir. Trans., ii. 24 (1810).

⁵ N. Eng. Journ., viii. 109.

⁶ Bibl. de Thérap., iv. 555.

⁷ RUMSEY, in Med.-Chir. Trans., ix. 402; KENNEDY, Lond. Med. Repos., Feb. 1823.

⁸ Amer. Med. Record., iii. 155.

Durande, of Dijon, who reported seven cases of its complete success. He made use of a mixture, sometimes of equal parts of the oil and sulphuric ether, and sometimes of two parts of the former to three of the latter article. Of this a teaspoonful was to be taken every morning, fasting, and followed by a glass of whey or other diluent.¹ Its good effects were also attested by Sœmmering, Riehter, and other eminent physicians.² More recently Martin Solon has published a marked case of its success.³ Some authorities contend that the medicine acts as a solvent of the concretions in the gall-bladder or ducts, while others deny this operation, and refer the effects observed to an excited peristaltic action communicated from the duodenum to the gall-ducts.

Oil of turpentine, in consequence of its diuretic properties, may be employed in *dropsy* when a direct action upon the urinary organs, and especially upon the kidneys, involves no danger. It may be given internally, or applied by friction to the loins. It has sometimes been used to promote the discharge of small *calculi*.

In *debility or paralysis of the bladder* with incontinence or retention of urine, it is a very efficient remedy. Dr. Elliotson has used terebinthinate enemata successfully in some obstinate cases of *amenorrhœa*, apparently connected with local causes, and independent of anæmia. After prescribing the loss of twelve ounces of blood by venesection, he directed an enema to be administered consisting of half an ounce of the oil in a pint of barley water. Stimulating elysters have been advised by Ramsbotham and others to re-excite *uterine contractions* when they have ceased during labor, and those containing oil of turpentine are probably the best.

Murray states⁴ that oil of turpentine taken in honey had long been used by the vulgar as a domestic remedy for *sciatica* and *rheumatism*. In 1780 Home testified to its efficacy by the publication of seven cases cured by its means. Cheyne also recommended it as "a perfect cure for sciaticas" when taken in doses of half an ounce at bedtime, during four or from that to eight days.⁵ In France it was first recommended by Reamier, and afterwards by Martinet.⁶ The latter employed it very extensively and with great success. He states that when administered in cases of *sciatica* it produces a sense of heat in the stomach which also extends itself along the affected nerve, and that its beneficial effects are usually experienced within three or four days. If no improvement takes place within a week, he deems it un-

¹ BAYLE, op. cit., iv. 507.

² Diet. en 60 vol., iii. 464.

³ Bull. de Thérap., xxxvi. 297.

⁴ Apparat. Medicam., i. 27.

⁵ LEWIS, Mat. Med., ii. 419.

⁶ Thèse, sur l'emploi, &c., 1818; Mémoire, &c., 1824 and 1829.

necessary to prolong the use of the remedy. In his hands the oil effected a cure in fifty-eight out of seventy cases of sciatica, and was given in doses of not more than thirty drops three times a day.

Other proofs of its curative powers are reported by Rayer,¹ who used it also in facial neuralgia, and by Laroque, Dufour, &c.² It was prescribed as a remedy for *epilepsy* by Latham,³ under the impression that in certain cases the disease might depend upon worms or foul bowels as a cause. Percival⁴ effected only a temporary cure by its use, in three female patients; and Lithgow⁵ was not much more successful.

Oil of turpentine was recommended by Carmichael in the treatment of *syphilitic iritis*, and other deep-seated inflammations of the eyes, in the dose of a drachm three times a day. In iritis he did not regard it as superior to mercury, or even of equal efficacy, but looked upon it as a valuable resource in cases which do not admit of the mercurial treatment. There is some reason to believe that its benefits, such as they were, depended upon its purgative operation. This, however, is not the opinion of Flarer, an oculist of Pavia, who asserts that the remedy subdues the local pain, congestion, and lachrymation, even when it confines the bowels.⁶ Recently inhalation of the vapor of this medicine has been proposed by Skoda in the treatment of *pulmonary gangrene*. He reports four cases in which it proved efficacious. In one of them only is the frequency or extent of its use intimated, and in that the inhalation was employed every two hours for five or ten minutes at a time.

Externally.—Oil of turpentine has for a long time been employed as a stimulant, rubefacient, or counter-irritant application, in cases of chronic pain and swelling of a *rheumatic* origin. In these cases it is generally associated with olive oil, or camphor, narcotic extracts, &c., according to the special indications presented. Dr. T. Smith recommends the employment of alkaline turpentine (or camphene) baths in chronic rheumatism, lumbago, sciatica, gout, &c. To prepare them he directs that one or two pounds of washing soda, with from three to eight ounces of oil of turpentine, be added to a warm water bath, which is to be repeated every second day.⁷ Baths of turpentine vapor for rheumatic affections have been proposed by Chevandier, in consequence of his observing that the workmen in the factories of Die cured themselves of these disorders by undergoing a sweating process in the

¹ Med. and Phys. Journ., lxx. 45.

³ On Diabetes (1811), p. 241.

⁵ Ibid., xi. 300.

⁷ BRAITHWAITE'S Retros. (Am. ed.), xxi. 355.

² BAYLE, op. cit.

⁴ Edinb. Med. and Surg. Journ., ix. 271.

⁶ Bull. de Thérap., xiii. 269.

furnace-chambers where the air is saturated with turpentine vapors, at a temperature of 170° to 180° F. He claims to have been successful in imitating this method. Patients, he says, can readily endure the bath at 140° to 160° F. for twenty or twenty-five minutes. Its effects are those of the hot-air bath, with the addition of a lively itching, and sometimes an eruption of the skin.¹ The late Dr. Hartshorne, of Philadelphia, proposed as a powerful stimulant and vesicant, a preparation made by boiling together oil of turpentine and powdered cantharides,² and which has since become officinal under the name of *Linimentum Cantharides*. It excites pain within half an hour, and vesicates within four hours. It is very apt, however, "to produce troublesome if not dangerous vesication," unless diluted with olive or linseed oil. It was originally employed as a stimulant of the skin of the extremities in the advanced stages of *typhoid diseases*, and also in some cases of *cholera infantum*.

Simple oil of turpentine, warmed, is a valuable application, as an epithem, in *puerperal peritonitis*, and in cases of simple *flatulent distension* of the abdomen.

Burns. It would appear that oil of turpentine was long a popular remedy for burns, among the operatives of Birmingham and Wolverhampton, in England, who were so well acquainted with the benefits attending its early application, that they commonly kept it in their workshops.³ It was, however, first introduced to professional notice by Kentish, in 1797.⁴ He directed the burnt part to be first washed with spirits of turpentine, and then covered with a cloth spread with a mixture of basilicon ointment and oil of turpentine sufficient to reduce it to the consistence of a soft ointment. This dressing was not to be removed for twenty-four hours, and then only for as long a time as might be necessary to apply a fresh one, after washing the part with warm laudanum and spirits of turpentine. The renewal of this application was to be made so long only as was necessary to establish a healthy action of the part, after which mild or astringent dressings were to be employed. Kentish applied his ointment both to superficial burns and to those which had destroyed in a greater or less degree the vitality of the part. Its advantages over the other methods were claimed to be that it cures more rapidly and with less pain; and experience seems to have established its claims to be used, if not as an exclusive method, at all events as one

¹ Arch. Gén., 4ème sér., xxviii. 80.

² Eclectic Repertory, i. 94.

³ Med. and Phys. Journ., v. 236.

⁴ An Essay on Burns, in two Parts, &c., 1797 and 1800.

far superior to the sedative and antiphlogistic plan which sprang from a false theory, and which, in virtue of that power which false theories exert even after their extinction, has continued to influence the medical world to the present time. To the influence of this theory must mainly be attributed the long neglect of the stimulant method of treating burns. In 1831, and again in 1838, Dr. Greenhow called attention anew to its value, insisting particularly on the importance of applying the ointment in such a manner as perfectly to exclude the air throughout the whole course of the treatment.¹ In this precaution, which indeed was not overlooked by Kentish, we may perceive an element of cure which the plan under consideration has in common with that of the raw cotton, flour and similar dressings.

Prompted by the apparent analogy between *erysipelas* and a superficial burn, Dr. Meigs supposed that a remedy which had proved so serviceable in the latter would also cure the former. He accordingly employed Kentish's ointment (*Linimentum Terebinthinæ*) in *erysipelas*, with excellent results.² In *frost-bite*, before inflammatory symptoms occur (chilblain), or after they have been succeeded by a dull livid color and other indications of feeble action in the part, the terebinthinate applications are superior to all others. *Gangrene* has been treated with compresses soaked in oil of turpentine, either pure or to which powdered cinchona or oak bark had been added. Thielmann states that he used this remedy with great success in 342 cases of *carbuncle*, during a period of eight years. He employed a mixture composed of an ounce of oil of turpentine and one of tincture of camphor, the yelk of an egg, and a pint of chamomile tea. This he applied, in every stage of the disease, upon a thick pad of charpie, which was then covered with oiled silk. This dressing excites a slight sense of burning, which, however, quickly subsides; "the epidermis softens, and the slough separates without the necessity of the crucial incision."³ When *deafness* depends upon dryness of the auditory canal and a deficient secretion of cerumen, a drop or two of this oil, mixed with an equal quantity of almond or olive oil, will sometimes restore the function of the part. Dr. Geddings, of Charleston, speaks highly of the efficacy of oil of turpentine as a remedy for the *sore mouth* produced by *mercury*.⁴ For this purpose it may be applied pure to the ulcerated surface by means of a camel's hair brush, or an emulsion containing it may be used as a wash or gargle.

¹ Lond. Med. Gaz., Oct. 1831, p. 49; and Oct. 1838, p. 82.

² N. Am. Med. and Surg. Journ., vi. 76.

³ Times and Gaz., Sept. 1855, p. 325.

⁴ Am. Journ. of Med. Sci., vii. 266.

ADMINISTRATION.—The dose of oil of turpentine as a stimulant is from five to twenty or thirty drops three or four times a day, and as an anthelmintic from two to four drachms every half hour until two, three, or four doses are given. It may be prescribed in emulsion with yolk of egg, gum, and sugar, and some aromatic water as a vehicle. The addition of a few drops of creasote, eajeput oil, or tincture of eapsieum, tends to prevent nausea, and from ten to twenty drops of oil of rosemary render it less disagreeable.

CREASOTUM.—CREASOTE.

DESCRIPTION.—Creasote (*κρέας*, flesh, and *σώζω*, I preserve) was discovered by Reichenbach, of Blankso, in 1832. It is procured by the dry distillation of various vegetable as well as animal substances. It is a colorless, oily liquid, of a peculiar, disagreeable, and penetrating odor, resembling that of wood smoke, and has a burning, acrid taste, which is perceived throughout the whole extent of the buccal, nasal, and pharyngeal mucous membrane. Its specific gravity at 68° F. is 1.037. It boils at 397° F., and is not frozen at —17° F. It burns briskly in the air, emitting large volumes of smoke. Creasote coagulates albumen, but exerts no action upon fibrin. It is soluble in alcohol, ether, the volatile and fixed oils, acetic acid, and alkaline solutions, and acts as a solvent of iodine, phosphorus, sulphur, and the resins. With water it forms two solutions, the one containing one part of creasote to eighty of water, the other one part of water to ten of creasote. To this peculiarity is due its property of preserving flesh from decomposition, and its entering into the composition of smoke and wood vinegar renders them antiseptic.

ACTION. *On Plants*.—Miguet¹ states that plants die when they are watered with a solution of creasote. A young and vigorous rose-bush, in full bloom, when thus treated, withered in the course of eight days. A few drops of the same solution, applied to a red rose, deprived it both of color and life.

On Animals.—Small *fish* die speedily in two ounces of water containing twelve drops of creasote. *Flies, wasps, spiders*, and other insects, show signs of great uneasiness at the contact of creasote water, and at length die in spasms.

This substance acts as an energetic poison upon *dogs*. Miguet gave daily, to a dog two months old, eight drops of diluted creasote. Its

¹ Chemical and Medical Researches on Creasote. Translated by W. WETHERILL, M. D. Philadelphia, 1835.

depressing effects were visible in the slow and painful gait of the animal, and the occurrence of frequent nausea, with tremulousness and emaciation. Cormack found that when given to dogs, in doses of thirty drops, it produced salivation, vertigo, muscular twitching, and insensibility. The same dose, administered to a *rabbit*, occasioned violent convulsions and speedy death.¹ In Miguet's experiments a dose of two drachms, administered to a young dog, gave rise to signs of distress, a fixed look, vertigo, dulness, and indifference. The respiration was labored, whining, and irregular; a secretion of mucus appeared to obstruct the air-tubes and hung from the mouth; eructation and violent retching ensued. At the expiration of two hours the breathing became extremely laborious and interrupted by long intervals, the limbs were tremulous and jerking, and death speedily ensued. The principal lesion discovered was universal vascular injection of the gastro-intestinal mucous membrane. The lungs were gorged with blood, and in the heart and great vessels this fluid was more firmly coagulated than usual.

The effects were much more rapid and serious when creasote was injected into the bloodvessels. When a drachm of the liquid was thrown into a vein, the heart abruptly ceased to beat. Thirty drops used in a like manner produced convulsions and death. In the arterial circulation the effects were less prompt and fatal. The breathing became labored and hurried, and there was vertigo and then stupor. These phenomena appeared to depend in a great degree upon the remarkable property possessed by creasote of coagulating the blood. A drachm and a half of the liquid was injected into the carotid artery of a dog. In half an hour the animal became drowsy and was convulsed, but at length recovered. In another experiment twelve drops of creasote were injected in a like manner. The animal uttered a sharp cry, during a few seconds breathed low and hard, and then appeared to become insensible. He, however, did not die. In neither of these cases did hemorrhage take place from the artery, although no ligature had been applied. This circumstance is not to be attributed altogether to the styptic power of the creasote employed, since it has been proved by numerous experiments that the coagulability of the blood in the lower animals is vastly greater than in man, a fact which explains the apparent success of various styptic nostrums when tested by experiments similar to those here related. Köhler of Warsaw performed an experiment upon himself in order to test the styptic property of creasote. Having made in his own arm an incision an inch in length by three

¹ A Treatise, &c., on Creasote. By J. ROSE CORMACK. Edinburgh, 1836.

or four lines in depth, he applied creasote water to it freely, but produced no other effect than a painful smarting. A drop of pure creasote was then introduced between the lips of the wound, which became very painful, and had its surface covered with grayish-white flocculi. The flow of blood stopped, but soon broke out afresh, and then soon afterwards ceased permanently. The wound remained painful and inflamed, but healed without accident.¹

On Man.—The experiment just described represents this action in part. More generally, pure creasote, when applied to the mucous membrane, or to the denuded cutis, acts as a powerful irritant and even as a caustic, exciting a burning pain, covering the surface of parts devoid of epidermis with a whitish film formed of coagulated albumen, and even producing ulceration. Wherever the skin is naturally delicate, or is rendered susceptible by disease, this application is very severe. Upon the conjunctiva it becomes intolerable, and when applied to the tongue it occasions, as already stated, a powerful burning sensation. The taste is so penetrating and peculiar that it can readily be detected in a solution of one part of creasote in ten thousand of water.

When creasote is swallowed in large quantity, it occasions severe and even alarming symptoms. There appears to be only one case of its fatal poisonous effects on record, and in that case the quantity of creasote swallowed was two drachms. Death took place in thirty-six hours.² Strumpf speaks of a woman sixty years of age who took "a considerable quantity" of creasote by mistake. She was immediately attacked by severe colicky pains, and within three hours had upwards of forty very painful and bloody stools. She recovered under the use of oil, milk, and opium. In smaller, or medicinal doses, it has, according to Headland, "a double action, being anodyne like hydrocyanic acid, and a mucous stimulant like turpentine." In doses of from one to two drops it produces a slight and temporary burning in the fauces and œsophagus. When large doses have been continued for some time, they are apt to occasion dulness, giddiness, fainting, and some excitement of the circulation, with difficulty of breathing, nausea or retching, muscular lassitude, yawning and constipation. The urine is generally augmented in quantity, but in diabetes is said to be diminished under the influence of creasote. This secretion is often darkened by it, as if it were colored by Indian ink, and exhales the odor of the medicine. Sometimes also it occasions micturition and even strangury. The quantity required to produce these toxical effects varies

¹ STRUMPF, Handbuch, i. 903.

² London Times, June 17th, 1839.

extremely. In some instances a single drop seems to have been sufficient, and in others as much as forty or even eighty have occasioned no bad consequences. These discordant effects are scarcely explicable unless upon the supposition that the medicine employed has been of various strengths, that its powers are neutralized by the habit of using it, or that the stomach contained food in some cases, and not in others. The vapor of creasote when inhaled is said to occasion stupor.¹ Corneliani relates the case of a woman who was attacked with faintness, trembling, efforts at vomiting, palpitation of the heart, &c., in consequence of the continued application of creasote water to a large ulcer of the leg.

REMEDIAL EMPLOYMENT. *Vomiting.*—Creasote was first employed to counteract this symptom, as it occurred in cholera, by Dr. Elliotson,² who states that his discovery of its anti-emetic property “was not the result of reasoning,” but of experiment. He subsequently made use of it in other forms of vomiting independent of gastric inflammation, and found that no medicine was at all comparable to it in allaying this symptom. He knew it to succeed where hydrocyanic acid had failed, and especially in nervous vomiting, the vomiting of pregnancy, in cases of obstructed bowels, and even in those of arsenical poisoning. He usually began with a dose of one or two drops, and if this was rejected it was immediately renewed. Weber confirms this statement of its efficacy so far as the vomiting in cholera is concerned. He gave one or two drops every two hours with mucilage of salep or gum Arabic.³ Dr. Burne found it peculiarly useful in relieving the morning sickness of intemperate persons.⁴ According to Dr. Neligan, in the obstinate vomiting of sea-sickness, this remedy has been found useful by some, and in many nostrums of the present day, for preventing sea-sickness, creasote is a principal ingredient. To allay the inordinate thirst and excessive craving for food in diabetes, creasote is usually one of the most certain medicines which can be employed.⁵ According to Rayer, it palliates the obstinate vomiting so frequently met with in Bright’s disease. In chronic diseases and even in malignant ulceration of the stomach, McLeod found it very useful, although less efficient than hydrocyanic acid.⁶

Hæmorrhages.—The first employment of creasote as a hæmostatic was in external hæmorrhages. Mignet had already, in 1835, shown its power of arresting the flow from a bleeding surface. This has

¹ CORNELIANI, Br. and For. Med. Rev., i. 265.

² Med.-Chir. Trans., xix. 217.

³ Bull. de Théor., xlv. 184.

⁴ Lond. Med. Gaz., xxii. 805.

⁵ Medicines and Their Uses, 4th ed., p. 336.

⁶ Lond. Med. Gaz., xvi. 598.

been abundantly confirmed by numerous observers. Burdach applied it with perfect success in hemorrhage from a gangrenous ulcer;¹ Thomson, in bleeding from a cancerous ulcer of the os uteri, mixed with a solution of gum tragacanth, and applied to the part upon a sponge;² Dasch, in hemorrhage after the operation of lithotomy;³ and many other examples to the same purpose might be cited. Its influence upon internal hemorrhages seems to be quite as great, if not still more decided. Dr. Allnatt used it successfully to arrest the bleeding of internal piles. Dr. Wragg, of Charleston, has reported fourteen cases, including hemorrhage from the lungs, bowels, bladder, and uterus, in which this medicine was given internally, and which appear to demonstrate its hæmostatic virtues.⁴ Arendt found it very useful in menorrhagia in non-pregnant women, and in some cases of unavoidable hemorrhage due to placenta prævia.⁵

Chronic Pulmonary Affections.—When first introduced, creasote was reputed to be curative of pulmonary consumption, but a more extended observation of its effects proved that it had no influence beyond producing a diminution of the bronchial secretion, and, in so far, a mitigation of the cough. In bronchorrhœa, however, and in the chronic catarrhs of old persons and those of a loose phlegmatic habit, the remedy proves useful both when given by the stomach and when inhaled. It is, however, less efficient and less easily tolerated than other terebinthinate medicines, and especially copaiba.

In *diabetes mellitus* creasote has been recommended by Berndt, and it does indeed appear to moderate in some degree the urinary discharge; but this effect is more unequivocally manifested in simple diuresis, or polyuria. Like the oil of turpentine, creasote possesses *anthelmintic* properties, and has been successfully employed for the expulsion of *tænia*, *lumbrici*, and other intestinal worms, but it possesses no evident superiority over the medicine named, if indeed it is equally efficient. Dr. Elliotson reports several cases of *neuralgia* affecting the spinal or facial nerves, in which this medicine appeared to effect a cure after other remedies had failed.⁶ The success obtained by Reich in *gouty and rheumatic* disorders from a tincture of soot prepared in a peculiar manner, induced him to try the internal use of creasote in these affections. He made the first trial upon himself, for the relief of a terebrating pain, with numbness and partial insensibility of the right leg, produced by cold. The attack resisted all the treatment employed

¹ Month. Journ. of Med. Sci., ii. 469.

² Times and Gaz., Aug. 1854, p. 213.

³ Edinb. Med. and Surg. Journ., Oct. 1841.

⁴ Charleston Journal, i. 121.

⁵ Brit. and For. Med.-Chir. Rev., xii. 558.

⁶ Med.-Chir. Trans., xix. 222.

until he began the use of creasote, which in nine days brought it to a termination. Another case of rheumatism afflicting several of the larger joints, and occurring in a lady, was cured by the same means. Marcus also recommended the medicine in atonic forms of rheumatic disease.¹ In fact, all the forms of this affection which are free from decided inflammatory action, are probably benefited by creasote, as they also are by the oil of turpentine.

Toothache.—When this complaint depends upon inflammation of the nervous pulp itself, the application of pure creasote generally mitigates or quite relieves the pain. Reichenbach first suggested the use of a mouth-wash of creasote water; but Saunders² afterwards recommended that, when the nerve was exposed, a small piece of cotton wet with creasote should be introduced into the carious cavity, but not in such a manner as to exert much pressure. Care should also be taken to protect the gums, cheek, and tongue from the corrosive action of the liquid. It was at first supposed that the creasote exerted an antiseptic influence, preventing the extension of the existing caries; but this impression was probably erroneous. In cases of rheumatic odontalgia a mouth-wash containing creasote alleviates the pain. The same preparation is also useful to correct fetor of the breath.

Leucorrhœa.—In many cases of the chronic form of this affection injections of creasote water have been found successful after the failure of other remedies. Sehmalz, Most,³ and Allnatt⁴ bestow great commendation upon this plan of treatment. The last-named writer used the following formula for an injection: R. Creasoti, liq. potass., āā ʒj; saech. alb. ʒij. Mix in a mortar, and add by degrees mist. camphor ʒvj. It is advised to use in the above mixture at first only ten minims of creasote. In *gleets*, Arendt found three or four injections of a mixture containing two or three drops of creasote to an ounce of muelleage sufficient to effect a cure.

When *deafness* depends upon a scanty secretion of cerumen, Curtis has known this remedy to act as a useful stimulant, and restore the impaired function. If the auditory canal is obstructed, it must first be cleansed with soap and water, after which its internal surface should be touched night and morning with a mixture of one part of creasote to four parts of almond oil.⁵ Burns have been advantageously treated by means of lotions of creasote water, with compresses wet with this liquid, or with creasote ointment, as they have with the terebinthinate preparations described in another place. The same applications are

¹ RIECKE, Die Neuern Arzneimittel., p. 256.

² Lond. Med. Gaz., xxii. 170.

³ RIECKE, op. cit. ⁴ Lond. Med. Gaz., xxv. 847.

⁵ Lancet, 1838-39, i. 328.

often useful in *chilblains*. In atonic, indolent, and varicose *ulcers* this remedy, of various degrees of strength, and in the several forms above mentioned, has been found to act as a wholesome stimulant by Reichenbach, Heyfelder, Berthelot,¹ Fife,² and others. It is peculiarly applicable in such as have flabby, fungous granulations, an ichorous discharge, a tendency to gangrene, or a connection with caries of the subjacent bones. In *cancerous ulcers* creasote has been found useful, both for the purpose of correcting their fetor, and sustaining the tissues against the progress of the destructive ulceration. Its antiseptic virtue has also been employed to correct the *fetor* of certain discharges. Thus, Haybach recommended that in *gangrene of the mouth* the affected parts should be touched with creasote on a fine camel's hair brush.³ Elliotson used the pure preparation in *mercurial stomatitis*, and injected a solution of it into the nostrils, with equal success, in a case of *chronic glanders* affecting the nostrils and frontal sinuses, with pain and a fetid discharge. The antiseptic qualities of creasote also render it useful as a means of correcting the fetor and counteracting the tendency to putrefaction of bodies used for anatomical purposes. With the latter object it has been injected into the blood-vessels. It is best adapted for the preservation of the nervous centres.

Cutaneous Eruptions.—Many diseases of the skin have been successfully treated by the use of lotions or ointments of creasote. A large number of authorities testify to its efficacy in the cure of *scabies*, but it does not appear to have any advantage over other methods which are less expensive and at the same time less uncertain in their effects. It sometimes acts very favorably in allaying the intense itching of *prurigo*, and more decidedly even in cases of chronic *eczema*. Martin-Solon reported the cure of a case of general *ichthyosis* by its use, and statements are not wanting of its favorable influence as a local application in *lupus* and also in the *Greek elephantiasis*. In spite of these and other examples of its utility, the remedy has not been generally adopted into the list of medicines which are most approved by physicians devoted to the treatment of skin diseases.

Warts, &c.—Rainey found pure creasote an efficient remedy for these excrescences, when they were thoroughly moistened with it and then covered for two days with a strip of adhesive plaster. The application rendered them soft and friable, and so easily broken down by friction that after several applications of it they were quite eradicated.⁴

¹ RIECKE, op. cit.

³ Bull. de Thérap., xlv. 44.

² Lond. Med. Gaz., xxii. 63.

⁴ Lancet, Dec. 1856, p. 545.

It has also been used in a similar manner for the cure of *corns*, by Vetter, of Berlin. Reichenbach found it a successful application to *condylomata*. Thorsten employed it with good results for the removal of *nævi materni*. He applied it to the tumor in a lotion of variable strength, on compresses, and several times a day. Its first effect was to produce excoriation; ulceration followed, and the tumor shrank and disappeared, leaving a smooth cicatrix behind it.

The smell of creasote is best removed from the fingers by washing them with chlorinated water. Its poisonous effects may be combated by stimulants, such as wine, coffee, ether, and its preparations.

ADMINISTRATION.—Creasote may be given in pill or in emulsion; the former mode is the less eligible of the two. It is said to be most readily miscible with water by means of an equal quantity of liquor potassæ; to this some aromatic water or tincture and a little syrup may be added, to disguise the taste. The same object is in a measure fulfilled by the creasote mixture of the Edinburgh Pharmacopœia, viz: Creasote and acetic acid, of each ℥xvj; compound spirit of juniper and syrup, of each f℥j; water f℥xiv. Mix the creasote with the acid, add gradually the water, and lastly the syrup and spirit. Each fluidounce contains ℥j of creasote. The *dose* of creasote is one or two drops, repeated at intervals of one or two hours, or only two or three times a day, according to the exigencies of the case. It may be gradually increased to nine or ten drops. Sometimes a single drop disagrees with the stomach, while in other cases forty and even ninety drops a day have been taken with impunity.

AMMONIÆ CARBONAS.—CARBONATE OF AMMONIA.

HISTORY.—This medicine is said to have long been known to the Hindoos. It is prepared by the Tamools according to the following formula: 'Take of sal ammoniac one pollum, chalk two pollums, dry the ingredients carefully, then mix them and sublime with a strong heat.' In Europe it was first described in the thirteenth century by Raymond Lulli. He prepared it from putrid urine, whence it was called *spiritus urinæ*. Its chemical composition was determined by Berzelius, in 1785.

PREPARATION.—When sal ammoniac (muriate of ammonia) is exposed to heat in an iron retort with chalk (carbonate of lime), a double decomposition takes place, and carbonate of ammonia is sublimed.

¹ AINSLIE, *Materia Indica*, i. 367.

This substance is not, however, a simple carbonate, but rather a hydrated sesquicarbonate, consisting of three equivalents of carbonic acid, two of ammonia, and two of water. According to another view of its composition, it is formed of one equivalent of the neutral carbonate, one equivalent of the bicarbonate, and three equivalents of water.

PROPERTIES.—Carbonate of ammonia occurs in commerce in the form of white, dry, hard, translucent lumps, of a fibrous crystalline texture. Its smell is pungent, but less so than that of caustic ammonia, and its taste is acrid and alkaline, producing a protracted irritation in the throat. By exposure to the air it becomes converted into a dull white pulverulent mass, of inferior ammoniacal pungency, and which is the bicarbonate of ammonia. It is soluble in four parts of water at 60° F., and also in proof spirit, but is imperfectly soluble in pure alcohol.

ACTION. *On Animals*.—Orfila gave two and a half drachms of finely powdered carbonate of ammonia to a dog of medium size. Two minutes afterwards, vomiting of yellowish and bloody matter took place. Six minutes later, convulsive movements began, and soon became general and frightful, affecting the muscles of the face, trunk, and extremities. These were succeeded by tetanic rigidity of the trunk in a backward direction. In twelve minutes the animal was dead. On examining its stomach, this organ was found to contain a good deal of bloody fluid, and its cardiac portion was deeply injected. A second experiment furnished similar results.¹ Mitscherlich, in his experiments upon rabbits, observed the following phenomena: Half a drachm of carbonate of ammonia dissolved in an ounce of water was injected into a rabbit's stomach. At first the animal became restless, but soon afterwards so feeble as to be unable to stand, spasmodic movements and tetanus followed, with rapid beating of the heart, and difficulty of breathing. There was no evacuation of the bowels, and in twenty-five minutes the animal died. The stomach, on dissection, showed no alteration, perhaps in consequence of its containing food, but there was vascular injection of the upper portion of the small intestine, and the epithelium of this part was dissolved. The blood was liquid, and coagulated very slowly, forming a very small clot. When the salt was introduced into the cellular tissue of the abdomen, tetanic symptoms, as in the first experiment, occurred, and the animal died in forty-two minutes. As in that, also, decided lesions of the small intestine were found. Externally it was very red, and within was filled with a

¹ Toxicologie, 5ème éd., i. 323.

reddish mucus, "which contained very few cylindrical cells, many cell-nuclei and globules, resembling the blood-globules in form and size, but so thin and delicate as readily to be torn."¹

Seybert injected into the crural vein of a bitch fifteen grains of carbonate of ammonia dissolved in two drachms of water, without producing any peculiar symptoms, except general tremulousness and spasms of the abdominal muscles, which occurred more than two hours after the operation. By the next day the animal had entirely recovered. Some time afterwards it was again used for experiment, and twenty-five grains of the salt injected into its veins. No peculiar phenomena were observed beyond evidences of pain and convulsions at the moment of the operation, and no bad effects were visible on the following day.²

As general inferences from such experiments Mitscherlich states the following: Carbonate of ammonia given to dogs, in powder, produces gastric inflammation, extravasation of blood, and death by spasm. On rabbits its solution acts more feebly than caustic ammonia. It does not purge, but being absorbed liquefies the blood, and it does not render this fluid, or the urine, alkaline. It has a specific action upon the small intestine (converting its epithelium into mucus), and equally so upon the spinal marrow, producing spasm.

On Man.—The only experiments upon healthy man with which we are acquainted were performed by Wibmer upon himself. But the doses he employed were too small to demonstrate the action of the drug. On one occasion he took six grains, which produced momentary uneasiness in the frontal region, and a sense of throbbing in the temples. After an interval of twenty minutes, he took six grains more, causing slight heaviness of the head and constriction about the temples. After another similar interval, the same dose was taken with like results, and finally, twenty minutes later, twelve grains dissolved in an ounce of water were swallowed. Apart from an irritative cough, and an increased secretion of bronchial mucus, no marked results ensued beyond what had already been observed. The appetite was not impaired. In none of the experiments was the circulation quickened beyond a few pulsations. Doses of twelve grains, according to Neligan, and of thirty grains according to Pereira, produce nausea or emesis.

The action of the salt, when used for a length of time, is probably different. Cazenave says that it then occasions pain in the abdomen, now and then diarrhoea, complete loss of appetite, a quick, frequent, and feeble pulse, paleness of the face, and loss of flesh and strength.

¹ Lehrbuch, ii. 287.

² WIBMER, Wirkung, &c., i. 133.

But the suspension of the medicine for a few days usually dissipates these symptoms.¹ Long ago Huxham wrote that this medicine, as a "volatile alkalious salt," tended to promote the acrimony and dissolution of the blood, and thereby promote its putrefaction. He states that when mixed with blood as it runs from a vein it quite destroys the texture of the blood-globules; and he further relates the case of a gentleman who was in the habit of eating it as other people do comfits. "The consequence soon was that he brought on a hectic fever, vast hemorrhages from the intestines, nose, and gums, every one of his teeth dropped out, and he could eat nothing solid; he wasted vastly away in flesh, and his muscles became as soft as those of a new-born infant; and he broke out all over his body in pustules, so that . . . after several months he died tabid, and in the highest degree of marasmus."²

Pringle performed some experiments which showed that carbonate of ammonia, so far from promoting the putrefaction of the blood, actually hinders this process, and he reasonably concluded that we should no more refrain from giving ammonia in low fevers, because it induces dissolution of the blood when used long and immoderately, than we should reject salt as a condiment, because an exclusive use of salted meat occasions scurvy.³ Moreover, it is only when the medicine has been taken for a long time that its supposed aplastic powers are developed, or exhibited. Pereira tells us that to an epileptic patient (a female), in the London Hospital, he gave fifteen grains of this salt three times a day for two months, without any apparent injury; and also that he has repeatedly prescribed a scruple three times daily for two or three weeks without any ill effect.

USES. *In Low Fevers*.—If the immediate and principal operation of carbonate of ammonia were to diminish the plasticity of the blood, its benefits in scarlatina, typhoid pneumonia, glanders, poisoning by venomous reptiles, &c., would be inexplicable. Even more singular would be its efficacy in *typhus fever*. Huxham, misled by his theory respecting the action of the medicine, maintained that as in typhus the fluids are already unduly alkaline; "the exhibition of volatile alkalious salts to the sick is adding fuel to the fire, for they certainly dissolve or break the globules of the blood, and hence more speedily bring on general putrefaction."⁴ Pringle, on the other hand, noticing this objection, replies that "they may be more efficacious in raising the pulse and expelling what is putrid, than hurtful by relaxing the

¹ Bull. de Thérap., xxxi. 59.

² An Essay on Fevers, pp. 299 and 308.

³ Diseases of the Army, pp. 315 and 316. ⁴ Op. cit., p. 307.

fibres and resolving the blood. However, *it is from experience, and not from theory*, that I take upon me to recommend the volatiles here."¹ Experience and theory, which here seem to conflict, may probably be reconciled by a reference to the facts above related, and observing that while the very protracted use of the medicine is debilitating, its immediate influence is stimulating. The latter appears to be spent upon the nervous system, the former upon the blood. When therefore a temporary stimulant is required, it may be safely sought in this remedy, even in diseases which would be aggravated by its prolonged use. In a word, its operation in typhus is closely analogous to that of alcoholic stimulants, but whether it possesses any qualities which should give it the preference over these in typhus fever is not, we think, conclusively demonstrated. During the epidemic typhus which occurred in Philadelphia in 1836, it was largely used by the physicians of the Blockley Hospital, where most of the patients were treated. In his account of this disease, Dr. Gerhard says of carbonate of ammonia: "Although we are perfectly aware of its power as a rapid and effectual stimulant, particularly when the fever is complicated with a disease of the respiratory organs, we were rather disappointed in its effects. It was irregular in its action, and in the dull muttering delirium of typhus seemed totally without power."² The present writer, who occupied the same field of observation with Dr. Gerhard, is able to confirm this statement, and must add that the repugnance to the medicine manifested by the patients was very great.

In *typhoid pneumonia*, in the pneumonia of persons advanced in life or of delicate or debilitated constitution, and when, towards the conclusion of ordinary pneumonia, the strength fails and expectoration grows difficult, the carbonate of ammonia becomes a valuable remedy, and may sometimes turn the scale in cases of imminent danger.³ It is probable that in such cases it not only acts as a general stimulant, but also modifies the character of the pulmonary secretion, rendering it both less abundant and less viscid.

In 1802, Dr. Peart, of London, described his use of this remedy in a very malignant form of *scarlatina*, as being singularly successful. He directed two drachms of the salt to be dissolved in five ounces of water, and two teaspoonfuls of the solution to be given every two, three, or four hours.⁴ Mr. Wilkinson in 1822 extolled it extravagantly, declaring "that he not only never lost a patient in this disease, but never had a case of the malignant kind, that even appeared dan-

¹ Op. cit., p. 300.

² Am. Journ. of Med. Sci., xx. 320.

³ CHAPMAN, Therapeutics; WILLIAMS, Cyc. of Pract. Med., iii. 445.

⁴ Med. and Phys. Journ., viii. 471.

gerous, or gave him a moment's anxiety."¹ Much more recently he confirmed his original statement, and extended its application to measles and other exanthemata.² In 1833, it was proposed as a specific in every form and stage of the disease by Strahl,³ and subsequently Baudelocque and Botrel⁴ found it singularly efficacious when the disease was marked by ataxic symptoms, delirium, subsultus tendinum, incrusted teeth, vomiting, a small irregular pulse, and involuntary discharges of fæces and urine, with a tardy or irregular eruption. Even in malignant cases with production of false membrane on the buccal mucous membrane and its continuations, with hemorrhage from the same parts, ecchymoses, delirium, adynamia, a small, frequent pulse, and anxious respiration, it sometimes availed to save life. In these accounts some exaggeration must be suspected, were it only because the disease continues to be, in its severer forms, one of the most fatal of its class. Besides, some cautious and experienced observers make a different report. Nevertheless, the value of the remedy is great, particularly when scarlatina assumes the low type which it is apt to wear in the crowded dwellings of the poor. Under these circumstances, says Dr. Charles West, "I have found it desirable to give ammonia almost from the outset of the disease, . . . and whenever the pulse presents the character of frequency and softness combined."⁵

The carbonate as well as the solution of ammonia has been recommended by physicians in the East and West Indies, and in the United States, as an antidote to the *bites of venomous serpents, insects, &c.* That the latter preparation will allay the pain and inflammation produced by the stings of bees and wasps is a familiar fact; and when this is taken in connection with the results of the employment of the carbonate in scarlatina and typhus, there would seem to be good reasons why the solution of ammonia should be used to counteract the symptoms produced by venomous serpents. If it does not directly tend to neutralize the poison, it at least co-operates with other diffusible stimulants in sustaining the system, until the natural powers eliminate the hurtful matter.

Like solution of ammonia, the carbonate may also be used to counteract the intoxicating effects of *alcoholic drinks*. When the patient cannot swallow, and the ammoniacal fumes applied to the nostrils remain ineffectual, a solution of twenty or thirty grains of the carbonate may be administered by the rectum.

Dr. Mackenzie reports two cases of *glanders* in the human subject which were cured by this medicine administered in five grain doses

¹ Med. and Phys. Journ., xlvii. 396.

² Lond. Journ. of Med., Sept. 1851.

³ Bull. de Thérap., x. 166.

⁴ Bull. de Thérap., xxxiv. 112.

⁵ Dis. of Infancy and Childhood, 3d ed. p. 599.

every hour or two in conjunction with alcoholic stimulants and nutritious food.¹

Under the name of "Peyrilhe's syrup," a nostrum consisting essentially of carbonate of ammonia was long celebrated for the cure of *chronic rheumatism, syphilis, and scrofula*. It required, however, to be used for many weeks together, and necessarily tended, if not carefully watched, to impair the strength seriously. Cazenave found the carbonate of ammonia a very powerful remedy in the graver forms of constitutional syphilis. He employed the formula recommended by Bielt, as follows: R. Syrup of mezereon ℥iv; syrup of tolu ℥x; carbonate of ammonia ℥j. S.—A tablespoonful night and morning.² The same writer has successfully prescribed carbonate of ammonia in several chronic affections of the skin which had been rebellious to other forms of treatment. This was particularly the case with *psoriasis*.³

In *chronic pulmonary catarrh*, whether complicated or not with emphysema, this medicine was employed and highly recommended by Laennec, Delioux, Guérard, Copland, and others, as favoring expectoration, and gradually causing the morbid secretion to subside. The following formula has been recommended: R. Camphor water ℥iij; carbonate of ammonia gr. xv to xxx; syrup of tolu ℥ss. S.—To be taken in tablespoonful doses in the course of twenty-four hours, and continued for several weeks. According to Rognetta,⁴ it is chiefly useful in thin feeble children affected with obstinate chronic cough or hooping-cough, with or without tubercles, and whose condition forbids the use of depletion. Under somewhat similar circumstances it has been recommended by Hope, but particularly when an asthmatic attack is connected with disease of the heart.⁵ It has also been employed in *croup* both internally, and externally as an ointment applied by friction to the sides of the neck.

Mr. Wallace, of Dublin, states that he has cured severe cases of *cancerum oris* by the internal use of this medicine, beginning with doses of five grains repeated every two or three hours.⁶ It may be surmised, however, that the local application of nitric acid, and the nutritious diet prescribed by him at the same time, had more efficacy than the internal medicine.

The extreme *debility of stomach*, attended with vomiting and spasms, to which many drunkards are subject, is said by Chapman to be alleviated by carbonate of ammonia. In like manner it relieves *cardialgia* affecting pregnant women, and in *sick headache*, a dose of it will, in

¹ RANKING'S Abs. (Am. ed.) xviii. 230.

² Bull. de Thérap., xxxv. 59.

³ Dis. of the Heart (Am. ed.), p. 391.

⁴ Traité des Syphilides, p. 604.

⁵ Annales de Thérap., vi. 50.

⁶ Dublin Hosp. Rep., vol. iv.

some instances, afford almost instantaneous relief. Alone, or associated with opium, it is a valuable remedy in *retrocedent gout* when its attacks are manifested by periodical colics, flatulence, cardialgia, and other symptoms of indigestion.

In 1840, Dr. Barlow proposed carbonate of ammonia in *diabetes*, as being at once a highly azotized substance and a diffusible stimulus. In four cases he found that it tended to restore the function of the skin, and so greatly to reduce the quantity of urine, as to render the patients comparatively healthy.¹ Subsequent experience of his own, and of Golding Bird, tended to confirm these results.² The same treatment has in like manner been found useful by Bouchardat.³

Siebold has highly recommended this medicine in cases of *puerperal convulsions* independent of an organic cause, but arising from irritability of the nervous system, and excited by debilitating influences. He used in connection with it, however, a great variety of other nervine and stimulant remedies, as well external as internal. It is also one of the numerous remedies proposed for *epilepsy*. Pereira employed it extensively, and in many cases with obvious benefit. It should be given, he says, properly diluted, in doses of from ten grains to a scruple. The form in which it proves most beneficial is that which partakes of the hysterical nature, "that syncopal form of epilepsy which Sauvages called *lipothymia*."

Carbonate of ammonia has been given as a sudorific in *acute and chronic rheumatism*.⁴ Dr. Wood regards it as peculiarly useful when the disease, although febrile, occurs in an asthenic state of the system probably dependent on impoverished blood, and is apt to be movable and accompanied with nervous irritation, a frequent and feeble pulse, a tendency to paleness, and perhaps coldness of the surface, and sweats during sleep.⁵ The ammoniated tincture of guaiacum has long been used in the treatment of chronic rheumatism, and in this, as in the acute form of the disease, not improbably operates in the same manner as the other alkalies, and their combinations with vegetable acids, which have now become a part of the recognized treatment of rheumatic affections.

As an *antacid*, carbonate of ammonia may be administered with advantage to neutralize acidity of the *primæ viæ*, and to correct the *lithic acid* diathesis, but is less eligible than the other alkaline carbonates and the salts of the vegetable acids. In doses of thirty grains and upwards this medicine acts as an emetic without producing much

¹ GUY'S Hospital Reports, v. 282.

² A Manual of the Pract. of Med., p. 519.

³ Annuaire de Thérap. (Suppl.), 1846. ⁴ CLARUS, Handbuch, p. 779.

⁵ Therapeutics, i. 572.

nausea or depression, and may, therefore, be employed in chronic bronchiti soccurring in broken-down constitutions, and wherever, in diseases of great debility, the bronchiæ become charged with mucus.¹ But the uncertainty of its operation renders it less eligible for these purposes than the sulphates of zinc and copper, or even mustard.

Like liquid ammonia, this salt may be used to stimulate the nasal mucous membrane in cases of *faintness*, *syncope*, *nervous spasms*, &c. Alone, or mixed with half its weight of sal ammoniac and scented with an aromatic oil, it is familiarly employed as a smelling salt by nervous women, and particularly for the relief of nervous headache. It is not without advantage in the forming stage of *coryza*; by its substitutive irritation it often puts an end to the attack.

Externally, powdered carbonate of ammonia is sometimes sprinkled upon the surface of poultices applied to glandular swellings, for the removal of exudation matter and of articular effusions. A salve is employed for similar purposes composed of one or two drachms of the salt to an ounce of fat, or a liniment made by adding to six drachms of an animal oil a scruple of carbonate of ammonia dissolved in five scruples of water.

ADMINISTRATION.—Carbonate of ammonia is generally given in watery solution, and its acrimony is blunted by the use of sugar and mucilage. It may also be given in an effervescing draught made by adding to a solution of *twenty* grains of the carbonate, *six* fluidrachms of lemon juice, or *twenty-four* grains of crystallized citric acid, or *twenty-five and a half* grains of crystallized tartaric acid. As a stimulant expectorant, the dose is *two* or *three* grains or more, repeated every two or three hours. In low fevers, from *five* to *ten* grains should be given every hour or two. As an emetic, the dose is *thirty* grains.

ARNICA.—LEOPARD'S-BANE.

DESCRIPTION.—*Arnica montana* (the flowers and root of which are medicinal, but the former only are officinal) is a perennial herbaceous plant. It grows in dry and mountainous places and in hedgerows, in Northern Germany, and other northern countries of Europe. It is about a foot high, having simple or compound golden-yellow flowers, and lanceolate, opposite leaves. The root is cylindrical, furnished with many fibres, of a brown color, and, like the flowers, has an aromatic odor, and an acrid nauseous taste. Both contain a volatile oil,

¹ NELIGAN, op. cit., p. 205.

which, however, exists more abundantly in the root, sixteen pounds of which, when dry, yield about one ounce of oil; both parts contain arnicin, an acrid resin, in about an equal proportion.

HISTORY.—The first mention of this medicine was made by Tabernæmontanus, one of the most eminent botanists of the sixteenth century. He states that it was a popular remedy among the Saxons for bruises, and other injuries accompanied with extravasation of blood. Its infusion was used to prevent or remove the effects of falls (hence it was called *panacea lapsorum*, *fall kraut*, &c.), to cure obstinate intermittents, rheumatic pleurisy, chronic cough, suppression of the menses, and lochia, and other affections in which pure stimulants are commonly employed. Collin, of Vienna, to whom we are chiefly indebted for its introduction into the *Materia Medica*, used it successfully in paralysis, amaurosis, putrid or typhoid affections, and in the diarrhoea of phthisis. Stoll affirmed its utility in several of these affections, but especially in asthenic dysentery. Indeed, Sprengel, from whom most of these particulars are borrowed,¹ says that all physicians admit it to be one of the most potent and searching stimulants that we possess.

ACTION. *On Animals.*—Viborg administered an infusion of this medicine to horses, and found that, in moderate doses, it increased the action of the heart, the flow of urine, and the warmth of the skin, and that these effects were accompanied and followed by a full pulse, muscular tremors, and depression. In larger doses it produced similar effects in a more marked degree. When the same preparation was thrown into the veins of a horse, it occasioned a flow of saliva, heat of skin, general tremulousness, with roughness of the coat, labored breathing, and a full pulse. To these symptoms succeeded general depression, with drooping head and closed eyes. The animal could scarcely stand, and finally lay down quite insensible to all external irritants. Within two hours he perfectly recovered. Effects entirely similar, but of longer duration, were observed in a cow.²

On Man.—The local action both of the root and flowers of arnica is that of an irritant; but that of the latter is the more powerful. If taken internally, arnica occasions a sense of irritation and burning in the fauces, with nausea, salivation, distension of the stomach, eructation, sometimes vomiting, and loss of appetite. It seldom disturbs the bowels, although in this respect the flowers are more active than the root. It also augments the heart's action and the quickness of respiration, the warmth of the skin, and both the perspiration and the urine. It appears to increase the bronchial secretion also, and occa-

¹ Hist. de la Médecine, v. 472.

² WIEBNER, Wirkung, &c., i. 231.

sions headache, giddiness, disturbed sleep, and pains in the back. If the dose be large, all of the functions are quickened, but dulness and a sense of weariness ensue.¹ The properties of the watery extract of arnica flowers, as tested by Schneller and other Vienna physicians, appear to be the same as those above attributed to the infusion. The local irritant operation of the medicine on the fauces and bowels was well marked, and also its stimulant influence upon the circulation. In several cases hemorrhage from the nose, or from the hemorrhoidal veins, took place.² In large doses its action is very decided, and, perhaps, not without danger. A soldier, mentioned by Barbier,³ took an infusion made with an ounce of arnica and six glasses of water, a glass every two hours, to cure an attack of intermittent fever. Soon after the first draught his breathing grew much oppressed, his head heavy and giddy, and the muscles of his limbs were affected with spasmodic movements. He was unable to rise, and fell when he attempted to do so. This condition lasted for half an hour, and every dose renewed it, but with diminished energy.

According to Richter,⁴ this medicine is appropriate to all diseases in which the powers of life are depressed, with diminished susceptibility of the system, torpor of the secernent organs, stagnation and obstruction, with a tendency to decomposition and gangrene. It is, he declares, peculiarly adapted to persons of a leucophlegmatic habit, but is contraindicated by augmented excitability of the nervous system, by general venous plethora, by active congestion of the brain or other important organ, and by great weakness and susceptibility of the stomach and bowels. When long used, it tends to confine the bowels, and in large doses is very apt to impair the digestion. In its stimulant action upon the nervous and muscular systems it resembles seneka, but has not, like this medicine, a special influence upon the pulmonary mucous membrane. Neumann states that the infusion of the flowers excites nausea, while that of the root does not.⁵ Oesterlen, one of the most recent of German writers on the materia medica, says the use of this medicine is almost obsolete, or ought to be so, for it is quite superfluous, and of no greater value than many other mild stimulants.⁶ This opinion is hardly warranted by facts; for the operation of arnica neither on animals nor on man is that of a feeble stimulant. Nor is it possible to suppose that such men as Stoll, Collin,

¹ JÖRG, *Materialien*, p. 182; WIRMER, *loc. cit.*

² *Zeitschrift d. Gesellsch. d. Aerzte zu Wien*, März, 1846, quoted by STRUMPF, *Handbuch*, ii. 51.

³ *Matière Médicale*, iii. 501.

⁴ *Ausführliche Arzneim.*, ii. 142.

⁵ *Heilmittellehre*, p. 93.

⁶ *Heilmittellehre*, p. 498.

Quarin, Hildebrandt, Hufeland, and Vogt have all been mistaken in supposing that they witnessed the effects which they ascribe to its use.

USES.—Stoll gave the decoction of arnica (3ss to 3j of the flowers in a sufficient quantity of water to make a quart of the decoction, sweetened, and given in doses of a cupful every two hours, or half of this quantity every hour) in "*putrid fevers*," when there was no inflammatory complication and the pulse was natural, while the strength and all the animal functions were very much depressed; also when the tongue was dry or covered with an abundant and foul mucus, or when the patient was dull, sluggish, and deaf, with muttering delirium. He generally preceded its administration by an emetic. It usually gave rise to flatulence and colic, but lessened the stupor. Sometimes the first doses excited vomiting, and nearly always they produced nausea.¹ Collin recommended it under similar circumstances; and Hildebrandt, while he points out, like Stoll, that it is very unpleasant to take, and frequently occasions nausea, yet alleges that sometimes its relief of the stupor, vertigo, and delirium is very decided, and that it tends to restore the function of the skin.² It is equally recommended by Voigtel, particularly when the abdominal distension and other intestinal symptoms are very marked.³ Richter advises it in various *typhoid conditions*, as in puerperal fever, typhoid pneumonia, and in the later stages of the ordinary form of pneumonia, when expectoration is difficult and the depression of the system great (in combination with senega), and also in advanced stages of inflammatory affections of the brain. In certain *intermittent fevers* Stoll vaunted this remedy, which he used in the form of an electuary. It generally produced severe pains in the stomach, with a copious viscid perspiration, a full, slow pulse, and constipation of the bowels. He allayed the gastric symptoms with opium. This method, he states, transformed triple into double quartans, and these into simple quartans, which disappeared without relapse.⁴ The same physician, by means of this remedy alone, cured patients reduced to the last extremity by hectic fever, colliquative sweats, and diarrhoea, from suppuration, and who had previously taken large doses of bark in vain; so that, he remarks, "with its aid I did not despair when all seemed desperate." If the case was urgent, he administered a drachm and a half of the powdered root every two hours, and found that it rarely excited vomiting, or only in the beginning.⁵ In the epidemic and typhoid form of *dysentery*, he declared that he knew of no remedy more justly entitled to be called a specific.

¹ Médecine pratique, ii. 99.

² Du Typhus Contagieux, p. 210.

³ Arzneimittel., ii. 133.

⁴ Op. cit., ii. 104.

⁵ Ibid., ii. 453.

Arnica has been recommended in various forms of peripheral *paralysis*, as of the bladder and of the auditory nerve; also in advanced periods of central paralysis, after the complete subsidence of all inflammatory and irritative phenomena. In extravasations of blood, or *bruises*, after the tendency to inflammation has subsided, or been overcome by antiphlogistic agents, this remedy has been praised by Richter, as it was originally by the popular voice. The author named remarks as follows: sometimes powerful concussions and contusions of internal as well as external parts give rise to a state approaching paralysis both of the nerves and bloodvessels, from which passive congestion and swelling are apt to arise. Under these circumstances arnica, given as early as possible, is decidedly the most effectual remedy, and hence arose its names of *panacea lapsorum* and *fall kraut*. But the doses used must be large.

Arnica has also been vaunted, but on more equivocal grounds, in all kinds of *spasms* and *dropsies*, in *rheumatism* and *gout*, in *passive hemorrhages*, &c. Mr. Neligan states that he has found a tincture of the flowers useful in *nervous headache*.

Externally, fomentations made with the flowers of arnica, or lotions with its tincture, have been commonly employed for the relief of bruises, sprains, and local paralyses. The tincture with soap liniment is said to be a very efficient local stimulant. Neumann recommends fomentations of the flowers in vinegar. Powdered arnica flowers are stated to have been successfully used as a dressing to arrest the progress of mortification. The dry powder is sometimes employed as an errhine.

ADMINISTRATION.—The powdered root may be given in doses of from *ten to thirty grains*, several times a day. A *decoction* may be made with from *two drachms to an ounce* of the root in *nine fluidounces* of water, reduced to *six ounces*. Dose, a tablespoonful every two hours. The *infusion* is made with from *one drachm to an ounce* of the flowers in *six fluidounces* of water. The liquid should be carefully strained, so as to exclude all filaments. Dose, a tablespoonful every two hours. The *tincture* of arnica (*Cod. Hamb.*), is made by digesting arnica flowers ℥iiss in rectified spirit f℥xvj for six days, and expressing the liquid so as to obtain ten ounces. Dose, fifteen to thirty drops.

TOXICODENDRON.—POISON-OAK.

“The leaves of *Rhus toxicodendron*.”

DESCRIPTION.—*Rhus toxicodendron* and *R. radicans* are natives of the United States, and are not distinct species, but only varieties of the same plant. “I have frequently observed,” says Dr. Bigelow, “individual shoots from the same stock having the characters of both varieties. I have also observed that young plants of *R. radicans* frequently do not put out rooting fibres until they are several years old, and that they seem in this respect to be considerably influenced by the contiguity of supporting objects.” *R. toxicodendron* is popularly known as *poison-oak*, and *R. radicans* as *poison-vine*. The former is an erect shrub about three feet high, and its leaves are more toothed and lobed than those of the other variety; the latter is a climbing vine, with broad ovate acute leaflets, smooth and shining on both sides, but sometimes pubescent beneath, and bearing small greenish-white flowers and globular pale-green or whitish berries.

HISTORY.—The poison-oak, says Griffith,¹ was early noticed, and was described in 1635 by Cornutus as a species of ivy. It was known to the Indians both as a poison and as a medicinal agent, and the effects of emanations from it were mentioned by Kalm and other travellers in North America. In 1788, Du Fresnoi, an army surgeon of France, published an account of its supposed virtues in the treatment of cutaneous eruptions and of nervous paralysis.²

ACTION. *On Animals*.—Herbivorous animals, such as goats and cows, eat the leaves of this plant with impunity, but they affect dogs as a poison. According to Rossi, the juice of the plant, given to a dog with his food, produced mortal convulsions; and Van Mons relates that a large dog, exposed during a night to the emanations of the plant, died with general swelling of the body.³ In Orfila’s experiments upon dogs it appeared to exert a depressing influence. Introduced into the stomach of the animals, they were affected with giddiness and inability to walk; the pupils were dilated, and death took place without stupor or convulsions.⁴

On Man.—According to Horsefield, when taken *internally*, it displays the properties of an acro-narcotic, and in small doses those of a direct stimulant, causing heat and uneasiness, and afterwards promoting perspiration and diuresis. Giacomini, on the authority of Van Praag,

¹ Medical Botany, p. 184.

² MÉRAT and DE LENS, Dict. de Mat. Méd., vi. 80.

³ DIEU, Mat. Méd. iv. 581.

⁴ Toxicologie, ii. 132.

says that it gives rise to gay excitement, with nausea and vertigo, confusion of the senses, a sense of stricture of the temples, chilliness, thirst, a slow, small, and irregular pulse, diaphoresis and diuresis, trembling and convulsions, general faintness and debility, &c.¹

The action of this plant upon the *skin* is more familiarly known. It may operate by contact, however slight, or without contact, probably through the medium of an effluvium which it exhales. This is said to be more active by night and in cloudy weather. Some persons appear to be much more susceptible to its influence than others; indeed, the greater number experience no ill effects from it. This peculiarity is explained by supposing the skin of those persons who are obnoxious to its action to be unusually delicate. "The symptoms caused by it are violent itching, redness, and tumefaction of the affected parts, especially of the face, succeeded by heat, pain, vesication, and fever. In some cases the skin becomes covered with a crust, and the swelling is so great as to obliterate the features. These symptoms begin in a few hours after exposure to the poison, and are usually at their height on the fourth or fifth day; after which desquamation begins, and the distress diminishes. In some instances the eruption is less general, and is confined to the part exposed to actual contact with the poison; in others, again, the eruption continues for a long time, one set of vesications succeeding another, so as to protract the disease for an indefinite period." (*Griffith.*)

USES.—This medicine has been vaunted as a remedy for cutaneous eruptions on the ground apparently of its having cured such diseases by exciting a substitutive inflammation. It has also been used in the treatment of paralysis, and many names might be cited in evidence of its curative properties in this affection, as well as in amaurosis, incontinence of urine, in various forms of ophthalmia, &c. It, however, does not really appear to deserve sufficient confidence as a medicine to entitle it to retain a place among officinal drugs.

SERPENTARIA, vid. *Diaphoretics.*

¹ Mat. Med., p. 564.

CLASS VI.

CEREBRO-SPINAL STIMULANTS.

IN no department of the *Materia Medica* is classification so difficult as in that which relates to medicines affecting the nervous system. Until recently their divisions into narcotics and antispasmodics was deemed sufficient. The former class contained all the agents which diminish sensibility, and the latter all which allay irritability without affecting sensibility. But a narrower examination and analysis of the phenomena produced by members of the two classes showed that they differ greatly from one another in regard to the particular functions which they appear to control. Thus, in the former, opium, whose force is expended chiefly upon the brain, was associated with conium, which, even in fatal doses, scarcely impairs the consciousness, and with aconite which does not directly affect the brain at all. Similar differences, often essential and radical, became apparent, and, indeed, were multiplied when the experimental analysis of primary nervous functions showed that they are quite distinct from one another, and are really so far independent that in different series of the animal kingdom each may exist alone. Thus, in the lower orders, which possess neither spinal marrow nor brain, the ganglionic system controls organic processes; in a higher class the spinal axis is superadded; and in a still more elevated sphere a brain, endowed with various faculties in degree and kind, and in man attaining its most perfect development, completes the fabric of the nervous system. In man it is at once the most complex and complete, for while in him all the processes of organic life, and all the animal functions, are as perfect as in any other creature, he stands alone in possession of an organ by means of which he can combine ideas, create imaginary circumstances, and be affected by thoughts of future events.

On each of these diversified functions of the nervous system there are medicines which exert a special influence. Some act upon the

brain chiefly, as the true narcotics; others exclusively upon the spinal marrow; and some have a special influence upon the nerves of organic life, or the ganglionic system, controlling through it nutrition and the action of the heart. A further analysis of the medicines which modify the functions of the nervous system demonstrates that some among them act as stimulants and others as sedatives of the whole system, of the brain, the spinal marrow, or the circulation. Hence it is seen that, instead of the arrangement in two classes, we must recognize several new ones, formed chiefly, however, out of original narcotics. In the further examination of them it will be apparent that several of the individual agents might not improperly occupy other places than the ones assigned to them; for it is peculiarly true of medicines belonging to this general division, that their action is, in a great degree, determined by their dose, and by the condition of the system at the time of their administration. Especially is this remark applicable to antispasmodics as a class, for their properties are scarcely exhibited except in the morbid states for which they form appropriate remedies.

NARCOTICS.

THE term narcotic is now applied to medicines which induce *sleep*; but in all except the most recent systematic classifications it also includes those which in any way lessen the *sensibility* of a part. The latter use of the word is more in accordance with its etymology, for it is derived from the Greek verb *ναρκεω*, which means to benumb, stiffen, or render torpid; and although some medicines produce their effect chiefly by diminishing the perceptive power of the brain, and others exclusively by their local action upon the nerves, they agree in palliating the sensation of pain. This distinction is not of modern invention, but is evident in the very terms which were anciently employed. *Hypnotica*, *soporifera*, and *somnifera* were the epithets applied to the former, and *anodyna* and *paregorica* to the latter group of narcotics. It is the former that we propose at present to examine, while the latter will be considered among antispasmodic and sedative medicines.

When narcotics are spoken of as medicines that produce sleep, it must be understood that reference is made to their direct and essential operation. For wakefulness may be due to a great variety of causes, some of which are direct and others are indirect. The former may reside in the encephalon itself, and consist of purely mental excite-

ment, or of material conditions, which may be sthenic, as in inflammation, or asthenic, as in debility consequent upon excessive stimulation. The indirect causes comprise all forms of irritation or pain in parts remote from the brain. Many medicines which are not narcotics, and many agents which are not medicines, may remove the causes of wakefulness, and thus indirectly occasion sleep. But true narcotics produce sleep, both when no influences are operating to prevent it, and often in spite of such influences, by exerting a more powerful action than theirs, and one of an opposite nature. It is, indeed, their peculiar virtue to blunt the senses and steep the mind in forgetfulness, in spite of pain, of nervous irritability, or of tormenting thoughts.

But, when the entire group of narcotics is examined, they are found to possess the power of producing sleep in very different degrees, so different, in fact, that if those articles are excluded which have been placed in other divisions of medicines affecting the nervous system by some authors, and those to which hypnotic virtues have been denied by others, opium only remains as the representative of the class, or rather as constituting this class alone. Thus, hyoscyamus, belladonna, and stramonium are expressly stated by Mr. Headland to be "not soporific;" Tully refuses the same quality to lactuca and humulus, and classes cannabis with euphrenic, as the first-named author ranks it with inebriant medicines. But the different articles mentioned are generally, and we believe correctly, regarded as possessing true hypnotic virtues, however feeble these may be in the case of some among them; while it cannot be denied that they become indirectly promoters of sleep in consequence of their anodyne or paregoric virtues.

The primary effect of narcotic medicines, except perhaps lactucarium and humulus, is to excite the mind and perhaps all of the functions, and at the same time to blunt the perception of external things as well as of bodily sensations. This doctrine has not always been acknowledged. On the contrary, one of the most acrimonious of the disputes which have divided the medical world grew out of the question whether opium is a stimulant or a sedative. Cullen maintained that narcotics "are universally and directly sedative;" yet, in almost the same page, declared that "in their first operation they often increase the force and frequency of the heart's action." And, as if to complete the confusion of his description, he asserted "that the stimulant and sedative powers of opium operate at one and the same time."

Undoubtedly the primary action of opium, as well as of other narcotics, with the exceptions above mentioned, is to stimulate the whole system, and often in so violent a degree as to occasion delirium. But

they may become sedative in their secondary operation, and that in one of two manners: either by blunting the sensibility of the system to pain or other cause of excitement, or, when given in excessive doses, by directly reducing the powers of life, and occasioning a torpor resembling that which alcohol and other pure stimulants produce, and which may terminate in death. But the latter operation has no relation to the medicinal action of narcotics, which is primarily stimulant in every case. It is not even proportioned to this action, for opium, which is the most powerful narcotic, is decidedly less stimulant than belladonna or stramonium, whose hypnotic virtues, on the other hand, are comparatively feeble.

It is unnecessary in this place to describe at length the phenomena produced by narcotic medicines, because they will be fully detailed in connection with the particular articles of the class; but it may be proper to indicate the more striking effects which, in a greater or less degree, they produce in common. Their primary operation, it has already been stated, is confined to the nervous system, and consists in the diminution or perversion of the sensibility to external impressions, and the substitution to a greater or less extent of ideas for sensations. Generally, this state is a pleasurable one, and is accompanied by feelings of tension in the nervous system and a disposition to bodily repose. Opium at this stage of its operation, and indeed subsequently, increases the perspiration, while belladonna and stramonium diminish it. On the other hand, these narcotics and hyoscyamus do not confine the bowels, but rather relax them, while opium tends in a remarkable manner to produce constipation. It restrains the secretion and emission of urine, and, as well as lupulin, displays anaphrodisiac powers. Belladonna, stramonium, and hyoscyamus dilate the pupil, but opium contracts it.

The further operation of narcotics is displayed, in the case of lactuca and lupulin, by a calmness which passes into gentle sleep; in that of opium by more or less fulness of the head, somnolence, or deep sleep, with heat and moisture of the skin; and in that of the remaining articles by cerebral and arterial excitement, irregular action and diminished power of the muscular system, and more or less delirium, which in some cases is extravagant or furious, and attended with hallucinations. Ultimately, when the narcotic operation is carried to its highest point, it terminates in complete insensibility. It may be produced by all of the articles of this class except lactucarium and lupulin, and is usually accompanied with evidences of cerebral congestion, such as convulsions, and feebleness of the circulation, coldness of the extremities and of the whole surface of the body.

The only medicines of the present class which are known to have caused death are opium, hyoscyamus, belladonna, and stramonium, and the only *post-mortem* lesions attributable to them are congestion of the brain and spinal marrow, lungs, heart, and great vessels.

There are very few conditions for the use of narcotics which cannot be fulfilled by opium alone. The principal exceptions to this rule are, the treatment of neuralgic affections and the relaxation of sphincter muscles, in which belladonna and stramonium are more efficient, and the resolution of spasmodic action generally, for which purpose these medicines, and also cannabis, are peculiarly appropriate. The action of hyoscyamus is more nearly allied to that of opium, of which it is a feeble representative and substitute, and from which, as already stated, it differs in relaxing instead of confining the bowels. This, and the two milder articles of the class, are generally employed when opium disagrees with the patient, or when it is intended to exert a soothing influence, rather than to blunt sensibility to pain.

The principal uses of narcotics are to relieve pain and allay irritation. Irritation, in a pathological sense, consists of abnormal movements and relations among the organic elements of a part; pain is the sensation from which the perception of such changes of condition arises. But irritation may exist without pain. When certain cold-blooded animals are decapitated, irritability of the whole body continues for many hours, and even in warm-blooded animals it does not cease with volition, for, as is now well known, the spinal marrow is a centre which reflects irritations, and converts them into organic or muscular movements which are wholly independent of the will or any other influence of the brain. An analogous condition is observed in man when the spinal marrow is diseased at its upper portion. The most complete disorganization of parts of the body below the neck may then exist without there being the slightest perception of pain.

Irritation, then, may manifest itself by disordered action with or without pain, and both of these manifestations narcotics have the power to control. It is true that the latter case, or irritation without pain, is one of comparatively rare occurrence; for, although in tetanus and hydrophobia there is pain, the convulsive derangement is disproportionately violent, and in epilepsy no source of local irritation may be discoverable. In the convulsions of infancy and childhood there is nearly always a local irritant as their cause, seated, generally, in some portion of the digestive apparatus, and proceeding from dentition, indigestion, worms, constipation, &c., and very often, if not most frequently, occasioning no pain.

In all of these cases, except hydrophobia, excessive nervous agita-

tion is appeased by narcotics. Even when the cause of the disorder remains, it acts less violently if the susceptibility of the nervous system is blunted by such medicines, and more time is afforded for the complete removal of the cause, either by the natural progress of molecular action, or the elimination of a morbid element, by the power of nature alone, or of appropriate medicines. It is perhaps in painful affections that narcotics most strikingly control spasmodic action. Pain, as was before remarked, is a peculiar impression, perceived by the brain, and, in general, the nervous derangement which results is proportioned to its severity. It often appears to be the exciting cause of convulsive attacks, but there is much reason to doubt whether it is really so, at least by a direct operation. The spasmodic act is a spinal phenomenon, and it is probably excited through the medium of the spinal nerves. Pain, however, augments the susceptibility of the spinal axis, as it does that of every part of the body, by exhausting its power and diminishing its tone. The relations of this great nervous centre to pain are exceedingly curious and interesting, and have not yet been thoroughly explored. Physiology does not explain how impressions from without, or morbid actions within the body itself, excite pain in remote parts. It does not, except by displaying an indirect organic connection between the parts, explain *how*, for example, uterine irritation becomes the exciting cause of toothache, or mammary irritation, during pregnancy; coxalgia, of pain in the knee; hepatic disease, of pain in the right shoulder; calculus in the kidney or ureter, of pain in the testicle, &c. But these phenomena, and many others that might be adduced, illustrate the mutual relations of pain and disordered muscular movements, and explain the importance of the part which narcotic medicines play as anodynes.

There are several other modes by which narcotics become remedies for painful diseases, and especially for those which are at the same time inflammatory. In all cases, without exception, of sthenic inflammation in parts supplied with nerves, the first step of the process is pain, and closely upon it follow congestion and effusion. To appease it is to set bounds to them; to neutralize it is often to prevent them. The influence of pain as an exciter of inflammation cannot be doubted, for we have only to remember that the purest form of pain, neuralgia, is often, when very severe, followed by swelling and redness of the parts in which it is seated. Narcotics, then, are antiphlogistic medicines, in so far as they assuage pain, by neutralizing one of the chief agents of irritation, under the operation of which the inflammatory process is developed. Very probably, also, they directly moderate and restrain the organic actions which are concerned in

inflammation. This, at least, appears to be the case with opium, which, in full doses, diminishes the activity of vascular movements, and indeed of every function except that of the skin. Hence the supreme excellence of this medicine in so many internal inflammations, and especially of organs which, like the intestinal canal and its investing membrane, have their movements as a whole, as well as their organic molecular actions, restrained by it without prejudice to the general welfare of the economy. Such is the reason of its value in dysentery and in peritonitis, and in those affections and injuries of external parts for the cure of which absolute rest is the most essential condition. It is less efficient in the treatment of inflammatory diseases of the brain and the thoracic viscera, because the continued activity of these organs is necessary to life, and doses of opium sufficient materially to restrain their action would be inconsistent with the adequate performance of their functions.

The administration of narcotics presents several peculiarities which, indeed, are common to all the agents affecting the nervous system. They operate in smaller doses than any other medicines. In the form of simple extract their ordinary dose is one grain or less, and in that of the alkaloids extracted from several of them, a small fraction of a grain. This circumstance should dictate extreme caution in their use. It is further to be observed that their effects vary considerably with the doses, the smaller producing phenomena in which stimulation predominates, the larger those in which narcotic sedation prevails. They also affect very young persons much more intensely than adults, and much more than can be accounted for by a mere difference of age. This fact is doubtless to be explained by the extreme activity and susceptibility of the nervous system in the earlier periods of life, and which has been dwelt upon in another place. It cannot be amiss to recall attention to this fact, an ignorance or a neglect of which has frequently led to the most deplorable results. Finally, all narcotics, and nervine medicines generally, lose their effect by repeated administration. In this respect they agree with all agents whatever, which act directly upon the nervous system. The habit of using any one of the class must therefore regulate to some extent the dose of it which is prescribed.

OPIUM.—OPIUM.

DESCRIPTION.—Opium is the concrete juice of the unripe capsules of *Papaver somniferum*. This is a species of poppy of which there are several varieties. It is a native plant of Asia, but now grows wild, or is cultivated in every part of Europe and the United States. Its culture, for the production of opium, has been chiefly carried on in India, Persia, Egypt, and Turkey in Asia, and of late years also in the south of France. The officinal poppy is an annual plant, five or six feet in height, bearing a large white, grayish, or violet-colored flower, which is usually single, at the summit of a tall, smooth, glaucous stem. The capsule which succeeds the flower is also glaucous when fresh; it forms an elongated or a flattened sphere, according to the variety of the plant, measuring from two to four inches in diameter, and is divided internally by radiated membranous septa containing an immense number of minute white or black seeds. These, when ripe, furnish a bland oil, and in Eastern countries, and in Italy, are used for food.

Opium is obtained from the capsules, as soon as their leaves are fallen, by making superficial incisions from which the juice flows and concretes in grains or tears. These are collected and sometimes reduced to a uniform mass by beating, after having, according to M. Texier, been moistened with saliva; but in other cases they undergo no such treatment, and consequently the mass of opium then presents a granular aspect.

As found in commerce, opium of good quality is in hard, brownish masses, which grow darker by exposure to the air, and are susceptible of pulverization. It has a peculiar strong odor, and a bitterish and slightly acrid taste. Opium is inflammable, and by burning swells up and is converted into a spongy mass. It is soluble in diluted alcohol and acids. It is a very complex substance: the proportions of its principal constituents are these: Morphia, 10 to 12 per cent.; narcotin, 6 to 7; codeia, 0.6; thebaina, 1; narcein, 6 to 7; meconin, 0.8; meconic acid, 5; extractive, 25; mucilage, 19; &c. The narcotic virtues of opium appear to depend chiefly upon *morphia*, which exists in it in combination with meconic acid. *Narcotin* is a substance which combines as a base with acids forming bitter salts. It is very inappropriately named, since it manifests scarcely any narcotic action. *Codeia* is found to exert a poisonous action upon animals, but its action upon man is said to be that of a stimulant of the nervous system, without narcotic properties, or at least without any except in very

large doses. This statement lacks confirmation. *Thebaina*, according to Magendie, is closely analogous to *strychnia* and *brucia* in its action upon the system. The other constituents appear to be inert.

The officinal preparations which contain opium, or some of its constituents, may be enumerated under the following heads:—

I. **Papaver.**—POPPY-HEADS.

A *decoction*, an *extract*, and a *syrup* of poppy-heads are officinal. The first has been used almost exclusively as an external application; it is superseded by solutions of opium. The other two preparations are also but little used, in consequence of their variable strength.

II. A second class of preparations comprises opium in substance, and its solutions in vinous, alcoholic, or acetous menstrua. These constitute by far the largest division of opiate medicines, whether for internal or external use. The following are all which at present are officinal:—

Pilulæ Opii.—PILLS OF OPIUM.

These pills are made by beating a *drachm* of opium and *twelve grains* of soap with water so as to form a mass, which is divided into sixty pills. Each pill contains, therefore, one grain of opium, whose union with soap renders it more soluble in the gastric juices.

Pilulæ Saponis Compositæ.—COMPOUND PILLS OF SOAP.

Half an ounce of opium, with *two ounces* of soap, are formed into a mass, of which every five grains contain one grain of opium. It has no especial advantage to recommend it. When smaller or larger doses of opium than one grain are required, it seems preferable to direct them extemporaneously. It has been suggested that these pills are convenient to prescribe when the fact that the prescription contains opium is to be concealed from the patient.

Extractum Opii.—EXTRACT OF OPIUM.

This preparation is made by intimately mixing a *pound* of opium with *five pints* of water, and evaporating the filtered liquor to a proper consistence. Of it Dr. Christison remarks: "It is a preparation now but little used, and for which pharmacy is indebted more to prejudice than to scientific investigation."

Confectio Opii.—CONFECTION OF OPIUM.

According to the U. S. Pharmacopœia, this confection is prepared by beating together opium *four drachms and a half*; aromatic powder *six ounces*; clarified honey *fourteen ounces*. It is intended as a substitute for *theriaca*, of which an account is given in the present article, and probably fulfils many of the purposes to which that ancient and multitudinous compound is adapted. Especially is it useful in cases

of simple diarrhoea occurring in debilitated constitutions during the heat of summer, and also in cases of feeble digestion, attended with pain and flatulence, in persons of a gouty habit. It is chiefly objectionable on account of its bulk when an anodyne operation is intended, since in every thirty-six grains of the mass there is only one grain of opium.

Trochisci Glycyrrhizæ et Opii.—TROCHES OF LIQUORICE AND OPIUM.

Powdered opium *half an ounce*, powdered liquorice, sugar, and gum Arabic, of each *ten ounces*, and oil of anise *a fluidrachm*, are mixed, and with water beaten into a mass, and divided into troches, each weighing six grains. Each one contains about one-tenth of a grain of opium. This preparation is much used for the purpose of allaying irritation of the fauces and air-passages in ordinary catarrh. Its efficacy is much increased by the addition of a small proportion of catechu. The *electuary of catechu* (*Ed.*), which is composed of catechu, kino, cinnamon, nutmeg, and opium, is a stimulant and astringent medicine, which is the modern representative of *diascordium*, and is very useful in atonic forms of bowel-complaint.

Pulvis Ipecacuanhæ et Opii.—COMPOUND POWDER OF IPECACUANHA; DOVER'S POWDER.

This valuable preparation is made by rubbing together powdered opium and ipecacuanha, of each *a drachm*, and sulphate of potassa *an ounce*. It presents a striking instance of the development of a third power by the association of two others of a different character. The quantity of either active ingredient in an average dose of this powder (ten grains) is too small to develop any marked effects, except perhaps a little drowsiness due to the opium; but the stimulant effect of the latter, associated with the sedative influence of the former, exerts a diaphoretic action, which comes most opportunely into play at the commencement of inflammatory and febrile disorders, and whenever, in their further progress, this action may be appropriate. It is generally inadmissible when nausea or gastric irritation is present. One grain of opium and one of ipecacuanha are contained in ten grains of the powder. The object of the sulphate of potassa is merely to facilitate the subdivision of the other ingredients. Owing to its greater specific gravity, it is said to subside to the bottom of the powder when this is long kept in the same position, so as to render the upper portions of the mass relatively stronger than the lower.

Acetum Opii.—VINEGAR OF OPIUM; BLACK DROP.

The officinal directions for this preparation are as follows: "Take of opium, in coarse powder, *eight ounces*; nutmeg, in coarse powder,

an ounce and a half; saffron *half an ounce*; sugar *twelve ounces*; diluted acetic acid *a sufficient quantity*. Digest the opium, nutmeg, and saffron with a pint and a half of the diluted acetic acid, on a sand-bath, with a gentle heat, for forty-eight hours, and strain. Digest the residue with an equal quantity of the diluted acetic acid, in the same manner, for twenty-four hours. Then put the whole into a percolator, and return the filtered liquor as it passes, until it comes away quite clear. When the filtration has ceased, pour diluted acetic acid gradually upon the materials remaining in the instrument until the whole quantity of filtered liquor equals three pints. Lastly, add the sugar, and by means of a water-bath evaporate to three pints and four fluidounces."

Six and a half minims of this preparation are regarded as equivalent to thirteen minims of laudanum or one grain of opium.

The advantages of black drop over opium or laudanum are, that it is less stimulating than either, and less apt than the latter to disagree with the stomach or affect the nervous system unpleasantly, while its anodyne and soporific effects are equal to those of the other preparations.

Tinctura Opii.—TINCTURE OF OPIUM; LAUDANUM.

Two ounces and a half of powdered opium are macerated for fourteen days in *two pints* of diluted alcohol, expressed, and the solution filtered. About two-thirds of the opium are retained in solution. Thirteen minims of the tincture, or about twenty-five drops, are regarded as equivalent to one grain of opium. This is the most common and largely employed of all the officinal preparations of opium, all of whose virtues it possesses. It is, however, more apt than opium, or than the acetated tincture, to occasion nausea and headache.

Tinctura Opii Acetata.—ACETATED TINCTURE OF OPIUM.

This tincture is prepared by rubbing *two ounces* of powdered opium with *twelve fluidounces* of vinegar, and adding *half a pint* of alcohol. After maceration for fourteen days, it is expressed, and filtered through paper.

This preparation is thought to be less apt than laudanum to disagree with the stomach, but in this respect it is probably inferior to the vinegar of opium. Its dose is ten minims, or about twenty drops.

Tinctura Opii Camphorata.—CAMPHORATED TINCTURE OF OPIUM; PAREGORIC ELIXIR.

"Take of opium, in powder, benzoic acid, each *a drachm*; oil of anise *a fluidrachm*; clarified honey *two ounces*; camphor *two scruples*; diluted alcohol *two pints*. Macerate for fourteen days, and filter through paper."

The association of camphor with opium and the other stimulants

composing this tincture modifies their operation in some degree, and renders it a valuable medicine for the relief of abdominal pains produced by flatus or irritability of the stomach or bowels, and for allaying cough when there is no active inflammation of the pulmonary organs.

One grain of opium is contained in half a fluidounce of the elixir. Its dose for an adult is one or two fluidrachms, and for an infant from five to twenty drops. It is generally administered in sweetened water.

Vinum Opii.—WINE OF OPIUM; SYDENHAM'S LAUDANUM.

"Take of opium, in powder, *two ounces*; cinnamon, bruised, cloves, bruised, each *a drachm*; white wine (sherry) *a pint*. Macerate for fourteen days, with occasional agitation; then express, and filter through paper."

Eight minims, or from six to seven drops, of this preparation contain the virtues of one grain of opium. It is, therefore, of nearly double the strength of laudanum. Wine of opium, like the other preparations of this drug with aromatics, is usually acceptable to the stomach; but is less used internally than as an external application in chronic inflammations of the conjunctiva.

Emplastrum Opii.—OPIUM PLASTER.

"Take of opium, in powder, *two ounces*; Burgundy pitch, *three ounces*; lead plaster, *a pound*; boiling water, *four fluidounces*. Melt together the lead plaster and Burgundy pitch; then add the opium previously mixed with the water, and boil them over a gentle fire to the proper consistence."

This is an anodyne and discutient application.

III. Morphia and its Salts. Morphia.—MORPHIA.

Morphia, the principal narcotic ingredient of opium, is obtained by means of precipitation with ammonia from a solution of opium in alcohol and water. As thus procured, the crystals of morphia are not colorless, and to render them so they are dissolved in boiling alcohol, and filtered through animal charcoal. Morphia is without smell, but is very bitter, and is imperfectly soluble in cold water, alcohol, or ether, but dissolves readily in hot alcohol. It is also soluble in fixed and in volatile oils, and in a solution of caustic potassa. It has an alkaline reaction. Owing to its comparatively insoluble character, morphia is seldom prescribed except in combination with an acid.

Morphiæ Acetas.—ACETATE OF MORPHIA.

This salt is prepared by the direct combination of diluted acetic acid with pure morphia. It forms slender acicular crystals, which dissolve very rapidly in water, but less so in alcohol. It becomes less

soluble by keeping, in consequence of losing a portion of its acetic acid. Its solubility, however, can be readily restored by the addition of vinegar or acetic acid. This salt has a very bitter taste. It is less frequently used than the sulphate for internal administration, but oftener endermically, in consequence of its greater solubility, when unimpaired, in the moisture of a blistered surface. One-sixth of a grain is generally esteemed equivalent to a grain of opium.

Morphiæ Murias.—MURIATE OF MORPHIA; HYDROCHLORATE OF MORPHIA.

This salt is prepared by the direct combination of diluted muriatic acid with morphia. It forms white tufts of radiated acicular crystals. It is very bitter, and is soluble in from sixteen to twenty parts of cold, and in eight or ten parts of boiling water. It is also dissolved by alcohol. It is more employed endermically than internally. Its dose is the same as that of the acetate.

Morphiæ Sulphas.—SULPHATE OF MORPHIA.

Sulphate of morphia is obtained by saturating morphia with diluted sulphuric acid. It crystallizes in delicate fasciculi of white acicular crystals of a silky lustre, which undergo no change by exposure to the air, and are intensely bitter. They dissolve in alcohol, in cold water, and in twice their weight of boiling water. The sulphate is the preparation of morphia most usually administered. Its dose, like that of the preceding salts, is one-sixth of a grain.

Liquor Morphiæ Sulphatis.—SOLUTION OF SULPHATE OF MORPHIA.

This solution contains one grain of sulphate of morphia to an ounce of distilled water. Its dose is a fluidrachm, containing one-eighth of a grain of the sulphate.¹

MEDICAL HISTORY.—Opium, from *ὀπός*, *juice*, is the inspissated juice of the poppy, and is supposed to have received its name in consequence of the valuable properties which rendered it eminently, *the juice*, in the same manner as cinchona is now called, simply, *bark*, from its superiority over all other barks. If, however, this etymology of opium is correct, there is a difficulty in accounting for the very slight notice taken of this medicine by the most ancient medical writers. The word opium, indeed, occurs in the Hippocratic books, and is there, as by Celsus, used to denote a narcotic medicine,² but is

¹ Codeia has of late been introduced into practice, but without any apparent necessity or propriety. "The medicinal properties of codeia," says M. Bouchardat (*Annuaire de Thérap.*, 1859, p. 10), "are almost identical with those of morphia, but five times as much of it may be given to produce an equal effect."

² ADAMS, Comment. on Paulus Ægineta.

not alluded to as it might be expected a medicine would be which was held in high esteem, or was habitually employed. The first writer to record its remarkable virtues was Dioscorides, who lived in the latter half of the first century of the Christian era. He says: opium allays pain, induces sleep, promotes menstruation, and is useful in chronic coughs. In overdoses it occasions a deep and terrible lethargy. Externally it is used with oil to allay the pain of headache; introduced into the ear, it relieves ear-ache; a suppository made with it is narcotic.¹ But it does not appear to have been extensively used until physicians of the Arabian school disseminated a knowledge of its qualities. In the writings of one of the most eminent of this school, Avicenna, who flourished at the commencement of the eleventh century, the medicinal applications of opium are shown at length,² and their enumeration comprises nearly all of those which are familiar to the practitioner of the present day. This author particularly alludes to its producing derangement of the mind, and of the digestive function. Rhazes says that two draehms of opium are a fatal dose; that they first produce torpor, and then insensibility, and sometimes general spasms, and that the eyes become hollow, the tongue thick, and the skin is covered with a cold sweat. He adds that the breath of the poisoned person, and also his internal organs, exhale the smell of opium.³ Under the influence of the Galenic doctrine, however, opium fell into discredit because it was condemned by this hypothesis as being cold, nor was it again received into the confidence of European practitioners until the sixteenth century, when Paracelsus and his successors in the chemical school renewed its vogue.⁴ During this and the following age, its reputation increased so much, that Sydenham, whilst describing the epidemic dysentery of 1669–1672, eulogizes this remedy in the most extravagant terms. “Without it,” he exclaims, “the healing art would cease to exist, and by its help a skillful physician is enabled to perform cures that seem almost miraculous.” Indeed, it was to Sydenham, Morton, Freind, Pringle, and other British physicians, that the various modern uses of opium may, in a great degree, be attributed. It is worthy of remark that the application of chemistry to opium has once more, in our own time, extended and facilitated its employment, by extracting from the crude vegetable product the alkaloid bases to which its activity is in a great degree due. Nareotina was discovered by Derosne in 1803; morphia by Seteurner in 1816; and codeia by Robiquet in 1833.

¹ Mat. Med., lib. iv.

³ EBN BAITHAR, ed. Sontheimer, i. 64.

² ADAMS, Comment. on Paulus Ægineta.

⁴ SPRENGEL, Hist. de la Médecine, v. 54.

ACTION. *On Animals.*—The influence of opium and its preparations upon the lower animals differs in a striking manner from that which they exert on man. According to Pereira,¹ a series of experiments instituted by Charvet, in 1826, shows conclusively that the narcotic influence of opium is distinct in proportion to the cerebral development of the animal. In the lower animals, the function of motility is especially affected by opium and its preparations; the invertebrate suffer debility, and paralysis of the contractile tissues, while the vertebrate below the rank of man are chiefly affected with convulsions, but birds alone manifest any stupor, except as an occasional phenomenon of poisoning by opium. Kölliker's experiments upon frogs prove that opium throws these animals into tetanic convulsions, when it is introduced into the stomach or into the spinal canal, and whether the continuity of the brain with the spinal marrow is preserved or not.² According to other experimenters, different results are obtained which depend upon the preparation of opium used, and the manner in which it is introduced into the economy. M. Lafargue³ having observed that the poppy was a favorite food of the rabbit, on which it thrived and grew fat, desired to know whether the animal would be affected by opium. For this purpose, he dissolved three grains of the acetate of morphia in a quantity of water, and mixed the solution with a certain quantity of bran, which a rabbit ate in two days, but was not in the least affected by it. Bouehardat reports that he has given large doses of opium to rabbits with similar results, and states that veterinary surgeons have administered from one to two ounces of opium to horses without producing any bad symptoms.⁴ Mulder gave a dog six grains of the acetate of morphia dissolved in water; paralysis of the hind legs, salivation, and somnolency with dilated but contractile pupils, followed. On the third day the animal was well. Another dog, which had swallowed six grains of the sulphate of morphia, recovered in the same space of time.⁵

In these cases the drug was introduced into the stomach, and there, in all probability, underwent a digestion which robbed it of its poisonous qualities, for we find that when either opium or morphia is more directly thrown into the bloodvessels, phenomena take place like those alluded to as occurring under the opiate influence in lower races of animals. Such was the case in Barbier's experiments upon horses,

¹ *Materia Medica*, Art. Opium.

² *VIRCHOW'S Archiv.*, x. 248.

³ *Am. Journ. of Med. Sci.*, Jan. 1847, p. 223.

⁴ *Manuel de Matière Médicale, et de Thérapeutique comparée, et de Pharmacie*. 2ème édition. Paris, 1846.

⁵ *Bulletin des Sciences Méd.*, 1827.

with the substances.¹ Four drachms of the aqueous extraet of opium dissolved in water were injected into the trachea of a horse. In eight minutes he reared, then went backwards, at the same time turning round, and raising his feet convulsively. In seven minutes more he was trembling all over, stretching out his neck, jerking his head convulsively, and tottering as he walked. Nine minutes afterwards, on being urged to walk, he fell, and showed no sensibility when rubbed or struck upon the spine. From time to time his head was abruptly raised, his ears lay back, and his eyes winked. Twenty-three minutes afterwards he was again upon his feet, but insecurely, when suddenly he sprang forward and fell. In three hours more he was breathing slowly, and the museles were contracting spasmodically; the heart beat strongly. He was not eomatose, not even dull, but continued to be convulsed until the expiration of three hours more, when he died. Another horse had about one hundred grains of acetate of morphia, dissolved in six ounces of water, thrown into his trachea; he lived three hours, and died in convulsions, after manifesting symptoms almost identieal with those in the case just described. The dissection of both of these animals showed the eerebro-spinal pia mater to be extremely vaseular, and, in the first one, the spinal canal contained a quantity of reddish serum.

In these and similar eases, the absence of eoma is quite inexplicable; for, although we may comprehend why the motory powers should be more exeited by an appropriate agent in those animals which have the corresponding nervous organs more developed than in man, yet there seems to be no reason why the organs of the speeial senses and of the instinctive emotions should not be affected in the same degree, and in the same manner, as in man. The faet of their inferior development ought not, one would suppose, to render them less impressionable to the narcotic influence. An experiment performed by Charvet proves that the convulsive movements which have been described are due to the influence of the narcotic upon the spinal eord. He found that a lizard affected in this manner by opium continued to be so even after the head was severed from the trunk. A further differenee alleged by Bouchardat² to exist between the higher and the lower animals relative to the influence of opiates upon them, is that while opium is most powerful in its effects on the cold-blooded tribes, morphia aets with greater energy upon the warm-blooded. He found that fish would die in an hour when placed in water containing one-thousandth part

¹ Matière Médicale, 4ème édition, 1837, v. 18, and 33.

² Annuaire de Thérapeutique, 1845.

of extraet of opium, but would live for three days in water containing a like proportion of morphia.¹

On Man.—It may be premised that there is very little difference between the action of opium and its salts upon the human system, and still less depending on the manner of their being introduced, whether this be done by the stomach or rectum, or finally through the skin deprived of its cuticle. It is true that the same individual may be somewhat differently affected by opium, and the salts of morphia, but another person may be impressed in a directly converse manner by these two forms of medicine, so that no general rule can be laid down according to which the one should be preferred to the other in a given case. The peculiarities of the patient, as shown by past experience in the use of opiates, must frequently determine our choice of the preparation to be given, and often the condition of the stomach will suggest the selection of that one which is least bulky, and therefore least liable to excite nausea or vomiting. But whatever the form of the opiate, or however brought into action, its effects are the same.

In small doses, as from a quarter of a grain to one grain, opium produces upon those who are unaccustomed to its use a soothing and luxurious calm of mind and body, followed, in the course of forty or fifty minutes, by a disposition to sleep, which gradually steals over the senses, and at last wraps the mind in unconsciousness; or, if sleep does not take place, there is a repose of the body undisturbed by pain or external annoyance, and a crowd of dreamy and pleasing thoughts sweep across the field of the imagination. At the same time the pulse, which was at first slightly quickened and more frequent, becomes somewhat slower, the mouth and pharynx are rather dry, and often perspiration breaks out upon the skin. The sleep produced by such a dose of opium may last all night, if the medicine has been taken at bedtime; during the day, it will hardly exceed two or three hours in duration.

Larger doses, as from one to three grains of opium, produce much more decided effects. The stage of excitement is more strongly marked, the head feels full, hot, and sometimes light, there are buzzing noises in the ears, the face and eyes are injected, while the pupil is more or less contracted. Flashes of light are apt to appear before the eyes; the ideas are confused and extravagant, and sometimes there is delirium; the pulse is fuller and more frequent; the skin is hot, the mouth and fauces dry, generally there is nausea, and in some cases vomiting. To these symptoms depression succeeds. The pulse beats

¹ Annuaire, 1846, p. 284.

more slowly, and often irregularly; the head feels heavy and full, and all the senses lose their acuteness; the countenance assumes a stupid, besotted expression, produced by the turgidness of the features, the dulness of the eyes, and the drooping of their lids; there is a strong indisposition to think or move, or, more properly, an inability to make any exertion either of mind or body; the speech is thick and hesitating, the muscles of the limbs are affected with spasmodic movements, and if the patient attempts to walk, he feels dizzy and oppressed, and staggers like a drunken man. An irresistible propensity to sleep promptly follows these symptoms, and when yielded to the breathing becomes laborious, and often stertorous, while the general surface of the body grows pale and damp, and the hands and feet cold. The sleep is sometimes deep, prolonged, and tranquil, but, produced by the doses mentioned, is much more apt to be disturbed by frightful dreams, from which the patient frequently awakes to relapse immediately into his previous condition. It should be borne in mind that the phenomena now described are those which ordinarily occur in persons who are not distinctly diseased; they are greatly modified by various morbid conditions, and by peculiarities of temperament, age, and other influences which will be mentioned in the sequel.

Narcotism. Poisonous doses of opium produce effects like those just enumerated, except that they are much more decided, and are not preceded by any distinct stage of excitement. They are thus described by Dr. Beek:¹ "The following symptoms are usually observed within a short time: giddiness, insensibility, and immobility, respiration scarcely perceptible, and a small feeble pulse, which sometimes becomes full and slow. The eyes are shut, the pupils contracted, and the whole expression of the countenance is usually that of deep and perfect repose. As the effects increase, the lethargic state becomes more profound, deglutition is suspended, the breathing is occasionally stertorous, the pupils are insensible to the application of light, the countenance is pale and cadaverous, and the muscles of the limbs and trunk are in a state of relaxation. Vomiting sometimes supervenes, and there is an occasional glimpse of returning animation, but the comatose state soon returns, and death, which is sometimes preceded by convulsions, rapidly follows."

The quantity of opium or of its preparations sufficient to produce all of these results cannot be stated with an approach to accuracy; a few drops of laudanum or a fraction of a grain of morphia may be fatal in young children, and, on the other hand, enormous doses of

¹ Med. Jurisprudence, vol. ii. p. 566.

either have sometimes been taken with only temporary inconvenience. Dr. Beck cites two cases, in one of which twenty-four, and in the other fifty grains of the acetate of morphia were swallowed, without causing death. A gentleman seventy-two years of age recovered from the effects of twelve drachms of laudanum;¹ another, aged thirty-five years, after half an ounce of this preparation had been taken;² and a third in which above an ounce was swallowed, and although the symptoms were intense, the patient recovered temporarily, at least, with paralysis of the right side.³ Another case is reported in which ninety grains of opium were taken by a female, who, however, recovered.⁴ An infant of twelve months has recovered from the effects of seventy-two drops of laudanum;⁵ another, six days old, after two grains of powdered opium;⁶ and a child, not quite six years old, from a dose of seven and a half grains of opium, which were, however, mixed with an equal quantity of prepared chalk.⁷

The distinctions between poisoning by opium and other narcotics may here be pointed out. Neither aconite, digitalis, nor tobacco produces stupor, nor does conium except in very large doses, and then not uniformly. Hyoseyamus, stramonium, and belladonna excite violent delirium, and extreme dilatation of the pupil. Inebriation by alcohol bears a very close resemblance to opiate narcotism in many cases, but the former state is preceded by confusion of ideas or complete delirium, and the breath is strongly tainted with the alcoholic odor.

After death from poisoning by opium, the convolutions of the brain are found to be flattened; the vessels of the cerebro-spinal axis and its investing membranes are gorged with black blood, and the capillaries of the brain give out on incision minute drops of the same fluid. A serous liquid is usually met with in the ventricles of the brain, and under the cerebral face of the arachnoid membrane. The lungs, heart, liver, and spleen are in most cases distended with dark and fluid blood.

Opium Eating. In some countries where the heat of the climate, or the prohibition of wine by religious exactment, restricts the use of alcoholic drinks, the innate and universal propensity of man to employ some artificial means of promoting the flow of agreeable thoughts, of emboldening the spirit to perform acts of daring, or of steeping in forgetfulness the sense of daily sorrow, has led the inhabitants to seek

¹ Lancet, July, 1857, p. 80. ² Boston Med. and Surg. Journ., Aug. 1855, p. 21.

³ Br. and For. Med.-Chir. Rev., xxii. 523.

⁴ Am. Journ. of Med. Sci., Oct. 1854, p. 385. ⁵ Edinb. Med. Journ., iii. 716.

⁶ Boston Med. and Surg. Journ., Dec. 1857, p. 357.

⁷ Am. Journ. of Med. Sci., April, 1859, p. 367.

for these coveted objects in the use of opium. Throughout the whole of southern Asia, but especially in its most opposite regions, Turkey and China, the consumption of opium for these purposes exclusively is so great as almost to exceed belief. Of late years, also, the habit of chewing opium has become very prevalent in the British islands, especially since the use of alcoholic drinks has been to so great an extent abandoned under the influence of the fashion introduced by total abstinence societies, founded upon mere social expediency, and not upon that religious authority which enjoins temperance in all things, whether eating or drinking, whether in alcohol or in opium. It is true that the latter article is not likely to become popular amongst an active and industrious race like the Anglo-Saxon, whose preference must always be for the more potent, though less permanent stimulus, of ardent spirits, the "gross and mortal enjoyments" of which are far more suitable to the character of that race, than the "divine luxuries" of opium. "If," says De Quincey,¹ "a man 'whose talk is of oxen' should become an opium eater, the probability is, that (if he is not too dull to dream at all) he will dream about oxen;" but men of active mind and warm imagination, as the Orientals generally are, will choose the stimulant which multiplies and gives a livelier coloring to the ideas, rather than that which, acting more especially upon what is merely sensual in man, excites to muscular exertion and boisterous mirth.

The philosophical but eccentric writer just quoted denies, upon his own experience, that opium produces intoxication, declaring its effects to be different from those of wine not only in degree, but in kind. The excitement produced by the latter is always ascending to a certain point which is soon reached, and then it speedily declines, while that from opium, when once generated, is stationary for eight or ten hours; the former agent disorders the mental faculties while it stimulates them, but the latter "introduces amongst them the most exquisite order, legislation, and harmony;" the one indeed warms and expands the feelings of the heart, but nearly always gives to an exhibition of them something of a maudlin character; the other promotes benign and charitable sentiments by removing, as it were, the irritation and moroseness which prevented their spontaneous display. Further, the excitement caused by opium is not followed by that depression and general derangement of the system which succeed excess in wine. The mischiefs entailed by the habitual abuse of these two stimulants are also different. Alcoholic drinks more commonly tend to bloat and swell the body, giving to the flesh a dull and sodden look,

¹ Confession of an English Opium Eater.

but without altering the color of the skin further than by producing red eruptions upon the face; long indulgence in opiates, on the contrary, renders the frame more attenuated, gives the flesh a dry and shrunken look, and to the complexion a dusky hue approaching to yellowness. The former reduces the mind to a state of childish and pitiful imbecility; the latter renders it sluggish, and torpid, chaining it down in sloth, but without wholly destroying its consciousness of power.

The kind and degree of ill health produced by opium eating are not well ascertained. We have more knowledge of the sufferings produced by an attempt to renounce the use of this drug, and which all witnesses concur in representing as intolerable agony. Besides being tormented by a perfect chaos and conflict of ideas of the most distressing nature, the miserable victim is a prey to perpetual terror, and feels in his stomach an urgent craving for a fresh supply of the now necessary stimulus, which has been often, and no doubt truly, compared to the literal gnawings of a ravenous animal. Against such demands few persons have the energy to struggle effectually, and their best success is apt to be nothing more than a power to refrain from increasing the dose, or at most to diminish it in some degree. The difficulty of renouncing the baneful habit of opium-eating, or even of approaching its renunciation, may be conjectured from the enormous quantities of the drug habitually consumed by its votaries. De Quincey states that he frequently took as much as 8000 drops of laudanum a day, or its equivalent, about 320 grains of opium. Many cases are recorded in which from one to two drachms were daily consumed; and Dr. Chapman relates¹ that, in a case of cancer of the uterus under the care of Drs. Monges and La Roche of this city, the quantity was gradually increased to three pints of laudanum, besides a considerable quantity of opium, in the same period.

Although it is probably true that a large majority of those who are addicted to the intemperate use of opium lose their health, and prematurely die, yet it should be known to physicians that the vice does not always entail such serious consequences. In Haller's Dissertations, it is recorded of a woman that from the age of puberty to beyond that of the menopause her daily dose of opium was from one to four drachms.² In connection with the case just alluded to, Dr. Chapman mentions another, of which he says: "I knew myself a wineglassful of laudanum to be given several times in the twenty-four hours for many months in succession, to alleviate pain from the passage of

¹ Elements of Therapeutics, 4th ed., ii. 200.

² Vol. viii. p. 303.

biliary calculi, and the patient finally recovered, without suffering from this excessive use of the article." Dr. Harrison, of Cincinnati, presents the following extraordinary case:¹ "A young lady of this city has for years, until lately, been in the habit of taking between five and six hundred grains of opium a day, and now can never do with less than seventeen grains of sulphate of morphia each day. The only disease she labors under is irregularity of the uterine function, accompanied by hysteria of the most strongly expressed character." Dr. Christison² was probably the first person to bring together any number of instances to illustrate the bearing of opium intemperance upon longevity. The paper referred to in the note contains ten authentic examples of persons who were for years in the habit of taking opium or laudanum every day in various quantities, the least of which would have been sufficient to kill one unaccustomed to this narcotic, and who, nevertheless, did not appear to have life shortened or health materially impaired by such excesses. A proof of the little injury produced in these cases is the fact that in several of them the habit of opium-eating was not suspected to exist; in others it may be added there was entire absence of constipation, a symptom, perhaps, the most unfailing of all which opium in small doses gives rise to. A case is mentioned, in the *Bulletin Général de Thérapeutique*,³ of a literary gentleman who had been long in the habit of chewing opium, and who for the last two years had consumed about one hundred and fifty grains a day. Its only injurious effect was to produce impotence. It is due to Dr. Christison to state that he did not conclude, from the cases referred to above, that the use of opium is not destructive to health; on the contrary, he distinctly declares his belief "that this habit will be eventually found not less destructive than the vice of drinking spirits." As yet, however, this proof has not been furnished.

Opium Smoking. This mode of obtaining the beatifying effects of opium does not appear to have been much in vogue except amongst the Chinese, although it is said⁴ that a party of Parisians, with the characteristic eagerness of the French for novel sensations, formed some years ago a club for smoking opium, each of the members of which was obliged to record in its journal the results of his experience.

According to Dr. McPherson,⁵ one of the latest writers upon the

¹ Elements of Materia Medica and Therapeutics, ii. 554.

² Edinb. Med. and Surg. Journ., Sept. and Oct. 1831.

³ Vol. xiv. p. 64.

⁴ BOUCHARDAT, Annuaire de Thérap., 1842.

⁵ "Two Years in China," quoted in Dr. BELL's Bull. of Med. Sci., 1843, p. 111.

subject, opium is never used by the Chinese in its crude state, but undergoes an imperfect purification which vastly increases the strength of the residuum. When used for smoking, it has the appearance and consistence of tar. A piece of this substance about as big as a pea is partially roasted at the flame of a lamp until it is reduced to a proper degree of inflammability, when it is set on fire in the bowl of a peculiarly constructed pipe, and its smoke drawn with one long deep inspiration into the lungs, which have previously been emptied as much as possible of atmospheric air. In this single whiff the opium becomes almost entirely dissipated. The fumes are retained a short time in the lungs, and then emitted through the nostrils, or, as by our own more dexterous smokers of tobacco, through the ears also. This operation is repeated until the effects of the drug are felt, a period which varies according to the susceptibility of the individual.

The effects of the opiate fumes when thus inhaled are said to be far more exhilarating and immediate, as well as more transient, than when opium is taken into the stomach. "The pulse," says the writer above alluded to, "vibrates, it becomes fuller and firmer; the face glows, the eyes sparkle, and the temperature of the skin is elevated, and it becomes suffused with a blush; the organs of sense are exquisitely sensitive, perspiration flows profusely, respiration becomes quicker, the action of the heart is increased, the nervous energy is exalted, and a glow of warmth, and sensations similar to those which often attend highly pleasurable and agreeable feelings, overspread the body." The mind shares in the general exhilaration, and is filled with those delicious and brilliant ideas which follow the other modes of employing opium; but if the smoking is too long protracted, these pleasing feelings vanish; "all control of the will, the functions of sensation and volition, as well as reason, are suspended; vertigo, coma, irregular muscular contractions, and sometimes temporary insanity, supervene."

Mr. R. Little has described the mode of smoking opium in Hindostan in terms nearly the same as those which we have quoted from Dr. McPherson, adding that, after the effect of the stimulant has passed off, "a state of languor, listlessness, and ineapability of exertion succeeds, together with loathing of food, nervousness, aching of limbs, gloom, and undefinable wretchedness, a state from which the smoker has no relief until the period comes round for renewed indulgence in the gratification which led to it, and which again infallibly induces it."¹

Dr. McPherson testifies to the comparative harmlessness of opium-smoking when not carried to an extravagant degree. "Were we,"

¹ Monthly Journ. of Med. Sci., June, 1850, p. 524.

he remarks, "to be led away by the popular opinion that the habitual use of opium injures the health and shortens life, we should expect to find the Chinese a shrivelled, and emaciated, and idiotic race. On the contrary, although the habit of opium-smoking is universal amongst the rich and poor, we find them to be a powerful, muscular, and athletic people, and the lower orders more intelligent, and far superior in mental acquirements to those of corresponding rank in our own country. The Chinese themselves affirm that the use of the drug acts as a preventive against disease; and in this opinion, when smoked in moderation, I am inclined in part to agree with them. Its effects, certainly, are not so disgusting to the beholder as those of alcohol on the sottish, slavish drunkard." The opinion of the Chinese respecting opium is very much like that of many in our country regarding tobacco, and proves that it would be as unfair to deduce the effects of opium-eating or opium-smoking from those produced by the drug in medicinal doses upon persons unaccustomed to its use, as it would to expect, from the habit of chewing or smoking tobacco, the violent and even poisonous effects which it sometimes produces when administered by the rectum in cases of strangulated hernia, or when first ventured upon by lads who imagine that it is manly to ape the vices of men.

Lest we should be suspected of a design to palliate the evils of using opium as an habitual stimulant, we refer again to the paper of Mr. R. Little regarding the effects of this vice, as he observed them in Singapore. After referring to the conclusions of Dr. Burnes from observation at the court of Lahore, and to those of Dr. McPherson which we have just quoted, Mr. Little draws a frightful picture of the derangement of the nervous system, and of the digestion, the oppressed breathing, and hazy, bleared eyes of the devotees of this vice. The sexual organs lose their power, and are affected with a gleet discharge, the flesh withers, and the bones are racked with pains. The stooping figure, shuffling gait, drooping eyebrow, and dull eye surrounded by a livid circle, give an appearance of premature decrepitude. In both sexes the procreative power is lessened, and in females the secretion of milk is defective. Ultimately the stomach is the seat of an incessant gnawing pain, the food is vomited, diarrhoea comes on, the urine is turbid, and Bright's disease is not uncommon.

Action of Opium upon particular Organs. It is unnecessary to repeat here what has been stated in the preceding remarks regarding the action of opium upon the *nervous system*; it affects this system primarily and chiefly, and all of its functions without exception, first

exalting their activity beyond the standard of health, and rendering the communication with the external world more perfect and intimate; then creating an internal world of new, and for the most part of grateful, perceptions; and at last drawing, as it were, the curtain over all real as well as fancied forms, produces complete unconsciousness.

On the Organs of Digestion. The influence of the occasional use of opium upon the appetite is very striking; it almost entirely destroys the cravings of hunger, and when it disposes to sleep, and during its narcotic influence, it inspires disgust for food. The power which opium has of repressing the appetite is effectually made use of by the Tartar couriers, who in their long and rapid journeys have no time to stop for refreshment. The habitual use of opium, however, seems to annul this effect; the stomach becomes tolerant of the stimulus, and learns to perform its function with considerable regularity; but when the usual quantity of the drug is much diminished, indigestion comes on, with that horrible craving before alluded to, which will not be pacified by food, but only by an increased dose of opium.

While opium diminishes the appetite for food, it augments the thirst, adding another to previous proofs that these sensations depend upon different causes. It is supposed by many that hunger is produced by the peristaltic movements of the empty stomach, causing attrition of the opposite faces of its lining membrane; on this supposition opium, by arresting these movements, and at the same time blunting the sensibility of the gastric nerves, would suspend or mask the sensation. Thirst, on the other hand, seems to be excited by dryness of the mucous membrane of the stomach, and, as we shall see, opium diminishes all of the internal secretions; a sense of dryness in the mouth and throat is indeed one of its first and most ordinary effects. Hence, we may plausibly explain why opium at the same time appeases hunger and excites thirst. It may be added, that these effects cannot be due to any merely topical action of opium in the stomach, because they occur with equal uniformity whether the opium be swallowed, or its salts be applied to the denuded skin.

Not only do opiates when first administered destroy the appetite, they also embarrass or suspend altogether the digestive process; the food which is taken while the system continues under their influence remains undigested, as is proved by the fact of its being subsequently rejected without having undergone any alteration; or, if the opiate is administered during the first stage of digestion, the subsequent assimilation of the food is retarded or prevented. MM. Trousseau and Pidoux hence derive their caution not to place a patient under the

influence of this drug while his stomach contains food, or immediately before eating.¹

The insensibility of the stomach to other stimuli, produced by opium, is perfectly analogous to that noticed in the case of food. It is a familiar fact that larger doses of emetics are required to produce vomiting in persons under its influence than either before or after its action, and this circumstance has a valuable application in the treatment of narcotic poisoning, in which considerable quantities of the most active emetics often fail entirely to evacuate the noxious substance.

Opium, however introduced into the system, is very apt to be followed by nausea or vomiting. The writers just quoted have noticed two varieties in the mode of production of the latter symptom. When the salts of morphia are applied endermically for several successive days, they excite vomiting during the first two or three days, and afterwards occasion only nausea; but when taken internally, vomiting does not take place during the first few days, but then commences, and continues during the subsequent administration of the drug. In either case, it occurs much less frequently in males than in females, and particularly in those of a nervous temperament. It is not to be supposed, however, that this symptom is at all of uniform occurrence; nausea, on the other hand, affects nearly all who use the preparations of opium medicinally, and with the peculiarities mentioned in regard to vomiting.

The paralyzing powers of opium are not less evident in its effects upon the bowels. Constipation almost invariably follows its medicinal employment, at least during the earlier periods of its administration; after its protracted use this symptom gradually yields. This has been observed in the opiate treatment of acute rheumatism by Drs. Corrigan, Stokes, and others. The writer treated a case of this disease in which the patient, after three or four days, took a grain of opium every hour; by that time it ceased to confine his bowels, which continued to be moved regularly every day. The suspension of the alvine secretions by opium, as well as the torpor of the intestinal muscles, doubtless contribute to promote constipation. It is probable, also, that, as observed by Sproegel,² the diminished secretion of bile may contribute to this effect; not that the liver so much fails in its function, as that the movements of the gall-ducts and of the duodenum, which solicit the discharge of bile, become sluggish and feeble.

¹ *Traité de Thérapeutique et de Matière Médicale*, 5ème éd., vol. ii. p. 15.

² Quoted by PEREIRA, *op. cit.*, art. Opium.

It has been found that morphia, used by the endermic method, uniformly produces constipation alone, while the same agent, given internally, confines the bowels during a few days only, and then, in some instances, occasions diarrhœa.

On the Circulation. The manner in which the movements of the heart are affected by opium is very far from being uniform. "Some writers," says Barbier,¹ "will have it that opium stimulates the heart, and makes the pulse more frequent, while others maintain that it enfeebles the vitality of this organ, and renders its contractions slower; on the one hand it is believed that the narcotic extract gives volume and resistance to the pulse, while on the other it has been observed to grow smaller and more corded under the influence of opium. Do not such opposite opinions about phenomena so easily ascertained prove that the action of the substance in question upon the circulatory apparatus is in reality complex and variable?" The correctness of this conclusion cannot be questioned. As a general rule, a full dose of opium renders the action of the heart stronger and more frequent in the first instance, and while the skin becomes turgid and red; subsequently, however, it reduces the frequency without diminishing the volume of the pulse. If, on the other hand, the person taking opium has that morbid susceptibility to its influence which is shown by its affecting the stomach more than the brain, and is nauseated or made to vomit, the pulse will be found irregular and feeble, and perhaps small. Or, again, if the drug be given in a poisonous dose, its first or stimulant influence on the circulation will be but momentary, its depressing powers will be more plainly shown, and, after a time, as coma and asphyxia approach, the pulse will be found small, weak, and irregular, qualities which it doubtless owes to the debility affecting the heart in common with all the other muscles, whether of organic or animal life.

On the Respiration. Opium influences the breathing precisely as it does the circulation; or it would be more proper to say that these two functions are simultaneously affected, and the disturbance of each interrupts the other. It is perhaps not possible to decide whether the excitement of the circulation is directly due to an augmented influx of nervous power, whether it is produced by the increased action of the lungs which takes place simultaneously, or whether, on the other hand, the activity of the respiratory movements is a secondary phenomenon, dependent on the greater amount of blood thrown into the pulmonary vessels. Nor is the question one of great importance, for

¹ Op. cit., tom. iii. 51.

we know that, as just stated, both functions simultaneously experience an increased activity. Respiration, however, becomes remarkably slow as the narcotic effects of opium are developed, and in cases of narcotic poisoning is indeed scarcely perceptible. On this account the blood which returns from the lungs to the heart has undergone but a very partial revival, and yet continues to circulate. Every moment, however, the proportion of oxygenated blood in the circulating mass grows less and less, until it reaches a point of impurity which deprives it of its power of stimulating the organs to perform their vital acts, and death at once takes place. This explains why the blood of those who have perished by narcotic poisoning is so intensely black, and why, also, the most effectual remedy for narcotic asphyxia is the introduction of oxygen into the lungs by artificial respiration.

On the Urinary Apparatus. Observers differ materially in regard to the effects of opium on the secretion of urine. Experiments upon quadrupeds would at first sight appear to show that the function of the kidneys is diminished, for Sproegel, Charvet,¹ and others found that animals to which opium had been given did not pass urine, in some cases, for several days; but it also appears from his experiments that the kidneys did not cease to secrete, although the bladder failed to discharge, urine. MM. Trousseau and Pidoux are the only writers who appear to have studied with care the influence of opiate preparations upon the secretion of urine. It results from their observations that it is more frequently diminished than increased, but that, in general, the use of an opiate, in pretty full dose (as one or two grains of a salt of morphia in twenty-four hours), must be continued for at least two days in order to produce either effect. The authors in question report that, in five cases of retention of urine caused by opiates, and in which no urine had been passed for one or two days, not more than six or eight ounces of liquid were drawn off when the catheter was used. A ready explanation of the diminished secretion of urine under the influence of opium is found in the copious discharge of fluid from the skin, which, as will presently be shown, takes place from the same cause. The skin and the kidneys are, it is well known, the two great excretories of the system, the former being most active in warm and the latter in cold climates or seasons, and the one serving as an alternate with the other. Unless, from some morbid cause, there is an excess of fluid in the body, activity of one of these organs indicates that the other is in repose.

The retention of urine produced by opiate medicines has been vari-

¹ Quoted by PEREIRA, op. cit.

ously explained. According to some, it depends upon the small quantity of urine secreted; but more than enough is usually contained in the bladder to excite its contraction, were not this prevented by some other influence. The power of opium to paralyze the muscles and blunt sensibility, as already pointed out in the case of the digestive organs, is quite sufficient to account for the phenomenon under notice. If it is objected that the urine is not, as in cases of paraplegic paralysis, discharged involuntarily, a sufficient answer is that the quantity collected in the bladder is at no time very large, except in very rare cases, in some of which, indeed, the urine drips away without the patient's consciousness.

MM. Trousseau and Pidoux have pointed out another cause of difficult urination arising from opiates, to which they attach a paramount importance, the diminution, namely, of the mucus which lubricates and protects the lining membrane of the bladder. Doubtless this membrane, like the mucous coat of the mouth, pharynx, and digestive canal, ceases to secrete mucus in due proportion when the system is affected by opium; to this cause we may fairly attribute the strangury which often attends the efforts to pass water, for the sphincter vesicæ is in all probability irritated to spasmodic contraction; but it does not appear to form a sufficient cause for simple retention of urine without strangury.

On the Organs of Generation. Opium is generally reputed to have the power of exciting the venereal propensity; but, as Cabanis well observes, it owes this reputation rather to its common stimulating properties than to any specific action, and renders more intense the feelings which happen to be indulged during its influence. Wedel, who maintains its aphrodisiac virtues, expressly states that they are manifested *in calidioribus, præcipue vero dispositis.*¹ The Sultan, upon his luxurious couch, is just as naturally inspired with sensual longings by the fumes of opium as the janissary or the spahi in battle is urged by them to deeds of blood and carnage. The fact that in the bodies of those who have died while under the influence of opium the penis has sometimes been found in a state of erection, proves nothing in favor of the specific aphrodisiac powers of this drug, but only shows these cases to be analogous to those of death by hanging, and other instances of cerebral congestion, in which a like phenomenon has been observed. The long-continued abuse of opium much more certainly induces impotence; yet, not by a direct organic action so much as by involving the whole system in debility. The menstrual discharge is sometimes

¹ HOFFMANN, Opera Omn., v. 81.

augmented by opiates. MM. Trousseau and Pidoux relate that in eight cases, under an opiate treatment, they observed either this increase, or the premature occurrence of the menstrual period, or else the return of the flow after it had been for some time suspended. The particulars of these cases are not, however, given; but, as they were treated in a hospital, it is probable that they were of diseases whose nature or progress was not wholly without influence on the condition of the menses. Dr. James M. Smith, of New York, has published several cases which appear to show, on the other hand, that the use of opium, in excessive quantities at least, tends to suspend the menstrual function.¹

On the Skin. Nothing is better established than the power of opium to excite perspiration. This property of the drug was well known to the ancient writers. Bonetus² says "we have hardly any diaphoretic so faithful, so certain, or which so well deserves the name;" and Cullen³ declares that "at all times opium has been found to be the most effectual of all sudorifics." Many of the old stimulant diaphoretics owed their activity entirely to the opium contained in them. Cases of poisoning by this agent strikingly illustrate its sudorific powers, for in most of them the skin is bathed in a profuse, and sometimes greasy and graveolent, sweat, while its temperature continues at the natural standard, or even above it. It is remarkable that, when the salts of morphia are employed endermically, the perspiration breaks out first in the neighborhood of the part to which the application is made, and thence extends to the entire surface.⁴ It is usually, however, most copious upon the face and breast. The heat of the skin is meanwhile increased, and remains so as long as the sweat continues, which is ordinarily for twenty-four hours. The manner of introducing morphia into the system does not modify the effects in question, except that their appearance is hastened when the endermic method is employed. The diaphoretic influence of opium is much more distinctly exhibited in females than in males. A very common effect of opiate medicines, and, if we are not mistaken, of the salts of morphia especially, is an intolerable itching of the skin; so intense is the irritation arising from this cause in some instances, that the anodyne and composing influence of the drug is entirely annulled, and the patient tosses about the bed, unable to find comfort in any position, and rubs or scratches every part of the body with violence. This itching is quite independent of

¹ N. Y. Journ. of Med., ii. 56.

² The Practical Physician's Guide; translated from the Latin. London, 1684.

³ Materia Medica, art. Opium.

⁴ TROUSSEAU and PIDOUX.

the cutaneous eruptions which opiates frequently occasion, and which usually consist of slightly elevated and reddish patches, resembling those of measles,¹ or are still more prominent and distinct, like the wheals of urticaria. The latter, as well as prurigo and eczema, are not unfrequently developed around the margin of the blistered surface upon which a salt of morphia has been sprinkled, and give rise to a very annoying degree of itching.

The Internal and External Use of Opiates compared.—MM. Trousseau and Pidoux are, so far as we know, the only persons who have made this comparison experimentally. For this purpose they selected persons as nearly as possible in similar circumstances, and administered to each from one to two grains of morphia endermically, or by the stomach. In the former case, thirst, vomiting, drowsiness, heaviness, and disturbance of the sight followed almost instantaneously; in some, these symptoms began to appear within two minutes after the morphia was applied to the denuded skin. In the latter, they did not arise in less than from one to three hours, and in most instances vomiting did not occur for several days. These experiments, whether performed upon different persons or successively upon the same, furnished identical results, and show either that cutaneous is more rapid than gastric absorption, or that the stomach assimilates or in some other way neutralizes a portion of the morphia received into it. They also prove that nausea and vomiting, when produced by opiates, are not owing to the direct action of these medicines upon the stomach, but to an indirect influence exerted by them through the brain, since the cerebral symptoms uniformly precede the gastric disorder.

Although the prompt and efficient action of opiates on the system ought not to be expected from their external application unless the cuticle is first removed, yet it cannot be questioned that they may be partially absorbed even through the unbroken cuticle, and, in some exceptional cases, produce distinctly poisonous effects. No fact is more familiar than the relief obtained by simply bathing a painful part with laudanum, or applying to it an opiate fomentation. The following case proves that even this method is not always unattended with risk: A young man was directed by his father, who was a physician, to apply a poultice sprinkled with a few drops of wine of opium to the pit of the stomach, for some slight ailment under which he was suffering. As the pain was rather acute, the patient determined to allay it by employing a larger dose than had been ordered, and accordingly emptied upon the poultice the whole contents of the vial, after which

¹ DUCLOS, *Annuaire de Thérap.*, 1847.

he went to sleep. Symptoms of narcotism soon appeared, and although the usual means were employed to combat them, it was in vain, and the patient died.¹

In the experiments above referred to, the effects produced by opium were the same for equal doses applied to the denuded skin and introduced into the stomach. This substance administered by the rectum occasions the same train of symptoms, but not in a like degree of intensity for the same dose. Whether, however, the dose requisite for producing through the rectum an impression equal to that caused by the ordinary quantities employed in the other two modes, should be greater or less than these, is still an unsettled question. Orfila asserts that opium is more active when given by the rectum than by the stomach, assigning as a reason for this statement the greater venous absorption and the inferior digestive power of the former. It is perhaps not surprising that this distinguished writer, who was not a practitioner, should have expressed an opinion founded on physiological data alone, but it is repeated by the authors last quoted as the result of actual experience. "We know," say they, "that medicinal agents given by enema operate more actively than through the stomach, provided they are retained equally long in both cases."² On the other hand, Dr. A. T. Thompson remarks that opium "acts, if not as powerfully, at least as rapidly when thrown into the rectum, as when taken into the stomach."³ Dr. Pereira also says: "Whenever I have had occasion to employ opium by way of enema, I always exhibit twice or three times the ordinary dose without exciting any remarkable effects." Cullen considered twice the ordinary dose by the mouth as proper to be given by the rectum. The statements of the English writers agree perfectly with opinion and usage in this country, and we are unable to account for so opposite a view, on the part of such eminent and accurate observers as MM. Trousseau and Pidoux, in regard to a subject of daily experience. It is probable, however, that one source of the discrepancy of opinion here alluded to is the fact that opium administered by the rectum sometimes finds that bowel empty, sometimes filled with feces, is sometimes entirely retained, and on other occasions partially or wholly expelled. It is evident that no uniform result can be expected under such various conditions.

Modus Operandi of Opium.—Until the nervous system was made to play a prominent part in pathology by the exclusive theories of Van Helmont and Hoffmann, the effects of opium were universally

¹ BOUCHARDAT, Manuel cit., p. 40.

² Art. cit.

³ Elem. of Mat. Med. and Therap., 2d ed., p. 414.

attributed to the absorption of its particles, or at least of its essence, into the blood, and its direct action upon the brain. During the greater part of the last century and a half, however, a different notion prevailed. "Opium," says Van Swieten, "does not act by dissolving and mixing with the humors, so as to pass by the laws of circulation to the brain; but by remaining in contact with the internal face of the stomach, it produces such a change in the nerves there distributed as blunts the perceptive faculty of the brain."¹ Modern experiments, and a careful analysis of the effects of opium, have gone far to overturn the later theory, and it is now very generally admitted that although this agent when applied directly to the nervous extremities may produce a local loss of sensibility, yet that its general or constitutional symptoms are entirely due to the vascular absorption of its narcotic principle.

The most important of the considerations which sustain this view are the following: Some time elapses between the application of an opiate to a mucous surface, or the denuded skin, before narcotic symptoms make their appearance. The interval is shortest when the preparation used is most soluble. The effects of an old opium pill are much slower in appearing than those of laudanum or a solution of morphia. In like manner narcotism is more speedily produced by the injection of an opiate into the veins than by any other mode whatever. When a person has swallowed a poisonous dose of laudanum, its effects continue for some time after the complete evacuation and cleansing of the stomach, proving that a portion of the drug has been absorbed, and continues to act upon the nervous system; and, on the other hand, if the laudanum is allowed to remain, the symptoms go on increasing, although the noxious agent is as completely in contact with the gastric mucous membrane during the first as any subsequent period of its operation. Again: The symptoms of narcotism are chiefly cerebral. Now there is no direct connection between an impression made upon a nervous extremity and the brain, unless that impression be also a sensation. In other words, if the direct action of the opiate were limited to the nervous extremities with which it is in contact, its remote effects should be displayed only in distant parts dependent upon the central ganglia of the cerebro-spinal system; but such is not the case; the immediate effects are observed almost exclusively in the organs of thought, while those of a more secondary character are displayed in parts supposed to be particularly under the control of the ganglionic and spinal systems.

¹ Commentaries on BOERHAAVE, § 229.

Besides these reasons in favor of the absorption of the active principles of opium, which, it will be observed, do no more than render it the more probable of the two theories under consideration, others remain which have the force of direct demonstration. There is in reality no greater barrier between an opiate in the stomach, and the bloodvessels, than there is between it and the ultimate branches of the nerves. A membrane intervenes which the opiate must traverse in order to reach either. It is the passage through this membrane which constitutes absorption, so that the act takes place whether the medicine be supposed to stop at the nerves or to mingle with the blood. To deny that it takes the latter course involves, consequently, a gratuitous assumption.

But, finally, and this constitutes a sufficient and unanswerable argument, the secretions of a person under the influence of opium possess the qualities of the drug. Its odor is readily detected upon the breath of those who habitually use it, as well as in their urine and perspiration, when large quantities have been taken. "I have seen," says Barbier, "a child remain for several hours in a state of narcotism after having taken the breast of a nurse who, a short time before, had swallowed a large dose of wine of opium to relieve cramp in the stomach."¹ The active principles of opium being absorbed into the system, they are presumed to act upon the nervous system, because the phenomena to which they give rise are clearly of nervous origin; but the manner in which these effects are brought about is altogether unknown, and cannot be even plausibly conjectured. Like all that relates to the intimate nature of nervous function, it is a vital act, not cognizable by the senses, and therefore constituting no part of human knowledge.

Many and acrimonious disputes have been held as to whether opium is a stimulant or a sedative. About as profitable was the more ancient discussion whether opium is hot or cold, and which had a very similar termination to that which the present debate will certainly have, to wit, that the substance in question was both hot and cold. The account above given of the physiological action of opium shows that in moderate doses, its primary action is to excite the mind, the senses, and the circulation; that in the same doses its secondary action is to calm the system, and for a time reduce nearly all the animal actions below the ordinary standard; and finally, that in excessive quantities it almost immediately depresses the powers of life. Hence upon these grounds alone, opium has an equally good claim to the title of sedative and excitant. That either may be given to it, according to circumstances,

¹ Op. cit., vol. iii. p. 60.

will be still more evident when we come to consider its therapeutical applications. If the sensible effects of opium under all the various conditions of dose, state of the patient, and external influences, were accurately known, there would probably be but little disagreement among physicians in regard to the generalization of these effects, but until they are much more accurately determined than at present, it is idle to dispute about the name or names to be applied to them.

Circumstances Modifying the Operation of Opium.—Age. It is only accordant with the general laws governing the effects of medicines that opium should act with peculiar force upon very young persons, but it is less in accordance with analogy that this substance should be much more capricious in its operation upon infants and children, than upon adults. The uncertainty of its action upon the young has long been known, and has led to the reiteration by medical writers of cautions in regard to its administration. Hoffmann denounces opiates as being injurious to children, not only through their immediate effects, but as leading, in some instances, to permanent mental imbecility, and loss of muscular power, a judgment which he confirms by citations from Willis and other high authorities, and he enjoins upon those who have the care of children not to follow the popular but dangerous custom of administering anodynes for very little attacks of colic, or other pain.¹ Van Swieten, in like manner, exposes the pernicious habit of administering opiates to infants, some of whom, he says, live quite stupid and besotted to the third or fourth year of their age.² This habit is scarcely less prevalent and mischievous at the present day; amongst the lower classes, nothing is more common than to administer laudanum, paregoric, or one of the earminative and opiate mixtures, not merely to assuage pain, but to keep children asleep while their mother attends to her household affairs, or some out-of-door employment. In England this criminal practice is, doubtless, far more general than elsewhere; for in no other European country, where the populace is so degraded, does there exist the same facility of procuring poisonous drugs. It appears from official documents that, in one district of Manchester, there were three druggists who sold *nine gallons of laudanum* weekly, of whom two testified that almost all the families of the poor in that district habitually drug their children with opiates.³ The same authorities furnish many examples of this vice, scarcely less appalling than the one which has been quoted,

¹ Opera Omnia. Geneva, 1748. Tom. i. p. 224.

² Op. cit., vol. xiv. p. 263.

³ Second Report of the Commissioners for inquiring into the State of Large Towns and Populous Districts; Br. and For. Review, April, 1844.

and which go far to explain the moral turpitude and mental and physical degradation of the people among whom it prevails.

It is not, however, so much the dangers of habitually using opium, by young children, as the fact that extremely small quantities sometimes produce very alarming symptoms, and even a fatal result in them, that is most important in the present connection. Trousseau assures us that he has frequently seen narcotic effects produced in children at the breast by a dose of the wine of opium, equivalent to one-hundredth of a grain of opium.¹ We have seen, upon the testimony of Barbier, that a child may be narcotized by the milk of a nurse who has taken opium. Bouehardat relates that nine new-born children at the Foundling Hospital of Paris were narcotized by the decoction of a single poppyhead, and mentions two other cases, in one of which death was caused by two, and in the other by two and a half drops of laudanum.² Dr. Sabotka, of Vienna, has recorded six analogous cases, in two of which death followed the administration of three or four drops of laudanum. One of the patients was seven, and the other between two and three months old.³ Among more recent cases of the same description, the following may be cited: An infant was attacked with alarming narcotism after taking one drop of laudanum; and another, eighteen months old, and affected with cholera infantum, died in six hours from an injection into the rectum of six drops of the same preparation.⁴ In London, an infant four days old was fatally narcotized by one-twentieth of a grain of opium, or about one drop of laudanum;⁵ and in Edinburgh the same effect was produced by two drops of laudanum in an infant also four days old.⁶

The late Dr. John B. Beek, after citing a number of instances similar to the above, and collected by him from English and American works on the diseases of children,⁷ endeavors to explain the remarkable energy and uncertain effects of opium which they illustrate, by invoking the susceptibility of the nervous system, and the great proportional quantity of blood which circulates in the brain of young persons. These conditions, and the proneness of children to be exhausted by intestinal discharges, he regards as accounting for the many cases, amongst them, of poisoning by small doses of opium. Without at all questioning the justness of these opinions, we would remark that there is another function still more active in the young than either innervation or the movement of the blood, to wit, absorp-

¹ Op. cit., tom. ii. p. 43. ² Annuaire, &c., 1843, p. 4. ³ Ibid., 1847, p. 5.

⁴ Am. Journ. of Med. Sci., Oct. 1854, p. 384.

⁵ Times and Gazette, April, 1854, p. 386.

⁶ Edinb. Med. Journ., ii. 146.

⁷ On the Effects of Opium on the Infant Subject, N. Y. Journ. of Med., ii. 1.

tion, as proved by the extreme rapidity of growth during infancy and childhood. To the singular energy of this function, it would seem appropriate to refer at least the disproportionate power of opium upon children; the uncertainty of its operation cannot, we suspect, be explained by any condition of their system which is not common to them and adults.

A knowledge of such facts as those above referred to has rendered physicians more circumspect than formerly in giving opiates to children. Dr. Beck very judiciously points out the precautions which should be observed in this particular. No form of opiate ought to be employed of which the strength is not accurately known; hence the syrup of poppies is not an eligible preparation. The first dose should always be smaller than the average, and never exceed one-eighth of a drop of laudanum for an infant under ten days, nor should a second be given until the effects of the first have sensibly declined.

Sex. The greater susceptibility of females to be nauseated by opium has already been pointed out; they also require smaller doses than males, and are more liable than men to be excited instead of soothed by the medicine.

Temperament and Idiosyncrasy. The influence of opium is most uniform and favorable upon persons of a sanguine temperament, provided that they are not suffering from a disease in which the circulation is full and excited; under these circumstances, it is apt to produce cerebral distress. The melancholic are not readily affected by opium, especially in cases when with a calm and even torpid exterior the mind is morbidly excited. This state, which is seen in an exaggerated form among the insane, is one in which larger doses of opiates may be safely given. Nervous patients are very differently affected by opium; some of them it soothes and invigorates; but it must be cautiously administered to the greater number, on account of the excessive agitation, sleeplessness, excitement and distress of mind, with vomiting, spasms, and itching of the skin, which it is apt to produce. In some, the susceptibility to these unpleasant consequences is so extreme as to render the prescription of opium for them highly improper. Occasionally, indeed, a prejudice against the drug aggravates, if it does not alone excite, disagreeable symptoms; but it must be admitted that they sometimes arise where the quantity taken is extremely small and concealed from the knowledge of the patient. It is generally thought that the salts of morphia are less apt to disagree with the persons alluded to than opium itself. Danyau, however, reports the case of a lady affected with cancer of the uterus who was dangerously narcotized by less than one-sixteenth of a grain of muriate of morphia applied to

the denuded skin of the epigastrium.¹ It occasionally happens that there is a constitutional insensibility to the effects of opium. Dr. Christison² says: "A gentleman of my acquaintance, not accustomed to its use, has taken 450 drops of the best laudanum without any other effect than some headache and constipation; and, singularly enough, his son, at the age of six, took 60 minims of the solution of muriate of morphia without any apparent effect at all."

Habit. The observations made under the preceding heads preclude the necessity of illustrating the influence of the habitual use of opium in modifying its curative effects. It may be remarked, however, that they show the importance of knowing when patients are addicted to the use of the drug, in order that the dose prescribed may be proportioned accordingly. In connection with this point, physicians should remember that, by continuing to employ opiates longer than is necessary, they may engender a pernicious, and, perhaps, incurable vice in those who find their stimulus agreeable. Their combination with other medicines will generally prevent this untoward result.

Pain, as already intimated, modifies in an extraordinary manner the influence of opiate medicines, to such an extent, indeed, that doses which would in health prove fatal are not only unproductive of harm, but, as in some cases of tetanus, and of biliary or nephritic colic, may fail to make any impression whatever.

Combination. Opium may be associated with nearly all medicinal agents for the purpose of modifying their action or its own effects. One of the most familiar examples of the former use is the combination of opium with mercurials, when the constitutional effects of the latter are desired. Blue mass, and calomel especially, are apt to produce a purgative effect which prevents their absorption into the system, but opium, tending rather to confine the bowels, opposes the discharge of the mercurials, and consequently promotes their absorption. It may, perhaps, conduce to the same end by blunting the sensibility of the intestinal mucous membrane. Most probably this is its mode of action when it arrests vomiting, or causes an irritable stomach to retain medicines which, without its presence, would be soon rejected. In these cases the dose of opium should not exceed what is necessary to insure its local action, a quarter of a grain, for example, or its equivalent of some opiate preparation.

Among the combinations intended to develop or augment the native virtues of opium, none is more valuable or in more constant use than its association with emetics, or nauseants, the effect of which is the

¹ Annuaire de Thérapeutique, 1845.

² Dispensatory, American edition, p. 710.

production of copious diaphoresis. The most valuable of these preparations is Dover's powder (*Pulvis Ipecacuanhæ et Opii*).

Another most valuable class of preparations is formed by the combination of opium with stimulants, particularly aromatics. The only representative of this class in the Pharmacopœia of the United States is *Confectio Opii*, which contains cinnamon, ginger, cardamoms, and nutmeg, and is intended as a substitute for the ancient *Theriac*, which has been rejected by our pharmacæutists as inconsistent with that principle of simplicity regarded by them as essential in medicinal compounds. The *Theriac* of Mithridates contains no less than seventy-one articles, of which fifty-eight are tonic or stimulant, one narcotic, five purgative or diuretic, and the remainder serve to unite these ingredients in the form of an electuary. This strange assemblage of drugs may indeed deserve the name of *monstrum pharmaceuticum*; but such are the number and weight of authorities in its behalf, that the justice of its condemnation in England and in this country may, without presumption, be doubted. Even Hoffmann, while suggesting that the mixture might be simplified, declares that it would be "rash to deny and reject the experience of so many ages in regard to it," and that, however contrary to reasoning it may be to look for benefit from such heterogeneous compounds, our judgment of their value should rest upon experience alone.¹ The French Codex still retains *theriac*, and, according to the most recent authorities, it is extensively used in France, because there is nothing else which so well fulfils the same indications. "It is particularly recommended in adynamic fevers, and in confluent smallpox and measles, when the eruption suddenly retrocedes, and serious disorder of the brain or chest supervenes; also when, at the commencement of an eruptive fever, diarrhœa retards or prevents the development of the eruption. It is preferable to opium in neuralgia of the stomach or intestines, especially in chlorotic subjects, and, in that case, is combined with iron. Its dose is from fifteen to thirty grains."² Each drachm contains very nearly one grain of opium. It was formerly much employed with bark in the treatment of intermittents, and, at a still earlier date, was used for this purpose alone.

Diascordium, which has fallen under the same ban on account of its complexity, is composed of eighteen astringent and tonic ingredients, with opium. Every drachm of the compound contains half a grain of opium. It is chiefly employed in chronic discharges from the bowels, and in acute diarrhœa after the febrile symptoms have subsided. The

¹ HOFFMANN, de Opii Correctione.

² TROUSSEAU and PIDOUX, op. cit.

authors last quoted remark that it is easy to understand how this medicine, into the composition of which enter so many substances rich in tannin, should act in the same manner as astringents, and in addition have the faculty of relieving local pain. The ordinary pill of acetate of lead and opium, the compound powder of kino, and other similar prescriptions, are intended to fulfil this double purpose.

Without expecting, or even advocating, the introduction of diascordium and theriaca into our pharmaceutical family, we could not refrain from alluding to the esteem in which they are held by observers who have no leaning whatever to medical credulity, in the hope that their example may lead practitioners in this country to pay more attention than they have done to the combinations of opiates with stimulants and tonics, and with vegetable astringents. The extensive prevalence of malarial fevers of a malignant type in the South and West, and of bowel-complaints in almost every section of the United States during the summer and autumn, would seem to present favorable opportunities of testing the virtues of these remedies or of analogous compounds.

The combination of opium with acids does not, according to Barbier, affect its medicinal qualities, and his statement is perhaps in accordance with general belief. Its correctness is rendered the more probable by the contradictory opinions of other writers. Cullen mentions the application of acids as a means of weakening the powers of opium which he found very effectual;¹ while the late Dr. Thompson declares that "with acids half the usual dose of opium will produce the effect of a full dose," a supposed result for which he found a ready explanation in the "production of a soluble salt."²

MODES OF ADMINISTRATION.—Opium and its salts are administered by the mouth, the rectum, and the skin. The first is the most usual medium, and, in the absence of any special contraindication, the most eligible when a prompt and general influence is intended. By the rectum a double or even triple dose may be given in the form of enema or suppository. Opiates are applied to the unbroken skin in plasters, fomentations, and liniments, for assuaging local pain; upon the cutis, denuded of its cuticle, as well for this purpose as for affecting the system; and by inoculation in cases which will be more particularly described in the sequel. When a salt of morphia is sprinkled upon the skin from which the epidermis has been removed by a blister, it excites severe smarting and burning pain; on this account the mor-

¹ A Treatise of the Materia Medica, ii. 258.

² Elements of Mat. Med. and Therapeutics, p. 402.

phia is usually mingled with finely powdered starch or gum Arabic, or else incorporated with lard. According to Barbier, the endermic method is not fully to be relied upon, for he found that in some cases no narcotic symptoms followed the application, while in others, under precisely similar circumstances, it gave rise to all the phenomena produced by opium taken internally.¹ The late Dr. James Johnson² proposed the inhalation of the vapors of opium by smoking it in a common pipe. This would, beyond a doubt, procure more rapidly and completely the sedative or anodyne influence of the drug than any of the other modes of administering it, and might at least be employed with those who habitually smoke tobacco. Powdered opium mixed with tobacco, or the latter steeped in a solution of the narcotic extract, would form an eligible means of obtaining the object in view, especially when the smoker is accustomed to draw the smoke into his lungs.

REMEDIAL EMPLOYMENT.—In treating of this portion of our subject, we shall, in the first place, consider the uses of opium in diseases which involve the whole system, or which, in whatever part of it they may occur, are attended with the same prominent and essential phenomena; and subsequently such of these as are more or less modified by the organ which they chiefly involve, together with affections of a still more local nature, and which are seated almost exclusively in a single organ or apparatus. Idiopathic fevers, inflammation, hemorrhage, and some chronic constitutional affections are included in the first class, and in the second disorders of the several groups of organs combined in the performance of particular functions.

Fevers.—Nothing is more embarrassing than an attempt to learn the use of opium in fevers from what has been written upon the subject, in consequence of the confusion in which the diagnosis of these forms of disease continues to be involved. Even the most modern writers are not agreed whether to regard typhus and typhoid fevers, the only two simple and serious continued fevers now admitted, as specifically different or as only varieties of the same affection. The older medical authorities render the inquiry still more perplexing to us by including many of the phlegmasiæ or local inflammations in the class of fevers, and also by failing to distinguish them when they arise as complications of genuine idiopathic fevers. To learn, therefore, the opinion entertained by one of these writers in regard to the uses of opium or of any other medicinal agent in continued fevers, it becomes necessary to compare carefully the history of the disease in which it was used by

¹ Op. cit., iii. 31.

² Med.-Chir. Rev., Apr. 1842.

him with those types which personal observation or the more minute and methodical descriptions of later times have rendered intelligible. Without at present attempting so arduous a task, we shall aim only at pointing out the precepts which experience has approved, and which, therefore, deserve confidence in proportion to their antiquity.

Among those which have been longest in authority are the following: Opiates ought not to be prescribed at the onset nor at the climax of a fever, but either during its augment, to assuage its violence, or during its decline, to support the strength and calm the nervous symptoms which are then apt to arise. In the former case they should be preceded by evacuants, and in both, if the head is hot, their influence will be promoted by the application of cold. The latter expedient is equally commendable in maniacal delirium, in which, also, opiates should be associated with nitre or some other sedative of the circulation. In this case, and also in mere watchfulness, or to combat ataxic symptoms, many authors recommend that opiates should be given in frequent and divided doses, so as to maintain a permanent effect, for large and infrequent doses will not control the evil symptoms without inducing a dangerous degree of stupor and subsequent exhaustion.¹ Hoffmann, who does not appear to have approved the ordinary use of opium in continued fevers, reiterates the caution against prescribing it upon the invasion of the attack, or when a crisis is about to take place. Sydenham, in describing the treatment of the continued fever observed by him from 1661 to 1664, and which, from its ordinary duration being fourteen or twenty-one days, was probably typhus fever, strongly recommends opium against one of its complications, maniacal delirium, or, as he terms it, phrenesis. In this state, he says, the patient cannot sleep, but cries out, mutters indistinctly, looks and talks wildly, and greedily swallows whatever is offered to him. After reducing, by means of evacuants, the violence of the symptoms, and not before the twelfth or fourteenth day from the commencement, Sydenham advises that a full dose of some opiate be given, by which means he declares that the delirium and fever are together brought to an end.² Cullen speaks of the value of opium in counteracting the delirium of fever, and agrees with previous writers in pronouncing it "a dangerous, or at least an ambiguous, remedy" during the active stages of the disease.³ But he is very careful to distinguish between its use in cerebral inflammation and in simple delirium with watchfulness and subsultus tendinum. In the latter he declares it to be a

¹ THEOPHILI BONETI, *Polyalthes*, &c. Genevæ, 1693.

² SYDENHAM'S Works, chap. iv.

³ Op. and loc. citat.

sovereign remedy, and directs it to be given in full doses every eight hours, unless sleep and a remission of the symptoms shall allow of longer intervals; but in the former it is most pernicious. It is extremely difficult, in many instances, to determine whether or not delirium is symptomatic of inflammation of the brain, nor can any more certain criterion be adopted than the effect produced by a small dose of an opiate or stimulant medicine; if, instead of growing more tranquil, the patient talks quickly, and his eye grows brighter, opium is clearly contraindicated.

Typhus. Hildebrandt¹ has very distinctly pointed out the proper occasion for prescribing opium in this disease. He insists that in the course of a simple attack of typhus it is not only unnecessary, but may be dangerous; by augmenting the stupor, and opposing the critical tendencies of the system, it prolongs the disease, tends to bring on apoplexy, and interferes with the salutary operation of other remedies. Its exhibition should be restricted to cases complicated, during their decline, with furious delirium, or profuse discharges from the bowels. In Great Britain, also, opiates are directed against these symptoms, but more particularly for the relief of tremors, watchfulness, and low delirium. Roupell states that at St. Bartholomew's, during an epidemic of the malady, it was "a daily occurrence to find that a patient who had been without sleep for several nights, whose whole frame was in a state of tremor, actuated by some erroneous idea, and constantly endeavoring to get out of bed, falls into a tranquil slumber on taking a dose of opium, and awakes refreshed and conscious, after several hours of calm and gentle sleep, during which the secretions will often be restored, the tongue becomes moist, and a warm perspiration breaks out."² Under these circumstances, the result is to be obtained by such a dose of opium as will soothe without stupefying, and is to be repeated at proper intervals. Dr. Latham ascribes no less importance to opium as a means of removing the symptoms above described; and Drs. Gerhard and Pennock, who had ample opportunities of treating the disease in the Philadelphia epidemic of 1836, state that when "the insomnia had been tormenting and incessant, and the patient was exhausted by agitation and nervous restlessness, a small dose of morphia would generally calm the agitation and procure sleep."³ Dr. Gerhard further remarks that typhus patients are very easily affected by opiates, and that an eighth or a sixth of a grain of morphia was usually sufficient for the purpose in view.

¹ Du Typhus Contagieux, trad. par J. C. Gasc. Paris, 1811.

² A Short Treatise on Typhus Fever (Philadelphia, 1840), p. 146.

³ Am. Journ. of Med. Sci., Feb. 1837.

Dr. Graves¹ has furnished some striking examples of the curability of severe cases of eruptive typhus by means of a plan of treatment into which opium enters largely. Among the symptoms which he describes as indicating it are violent delirium, a furious aspect, suffusion of the eyes, constant raving, and muttering, and perfect sleeplessness. Under these circumstances he administered every second hour a draught containing half a grain of tartar emetic, with ten drops of laudanum, and, if there was much subsultus, five grains of camphor. This mixture brought on vomiting or purging, or both, while at the same time the patient grew more tranquil and rational. Here the combination of sedatives and opiates effected what neither was capable of doing by itself.

Typhoid Fever. The diseases described by Huxham under the names of putrid malignant, and slow nervous fevers, correspond in their prominent traits with the typhus and typhoid forms of the existing nomenclature; the analogy is carried out in the treatment recommended for each by this eminent physician. While in the former he strongly recommends opium, particularly in combination with camphor, he finds but little occasion for its employment in the latter, declaring that strong opiates "are commonly pernicious, however want of sleep, or great restlessness may seem to demand them," for which symptoms indeed he insists upon blisters to the back of the neck.²

Since the distinct separation of typhoid fever from other continued febrile disorders, few, if any, accounts have been published respecting the influence of opiates on its symptoms. Louis, indeed, informs us³ that he found it effectual, when given in small doses, in moderating subsultus and delirium in mild cases of the disease, and suggests that the success of these experiments should encourage its employment in severer cases. Opium, however, is of much more value as a means of restraining the diarrhoea, and of averting the consequences of intestinal perforation, which sometimes augment the gravity of typhoid fever. To these points reference will again be made.

Eruptive Fevers. In these diseases, when they assume the typhoid type, opium is needed under circumstances similar to those which have just been described; but there is a still more important occasion for its exhibition, when the eruption comes out imperfectly, or shows a disposition to recede. It has been chiefly used to meet the former of these indications in the treatment of smallpox. The ancients recom-

¹ A System of Clinical Medicine, Dublin, 1843, p. 127 and seq.

² An Essay on Fevers, London, 1772, p. 82.

³ Recherches, &c., sur la Fièvre Typhoïde, 2ème ed., tome ii. p. 453.

mended that if the eruption did not appear actively by the fourth or fifth day, the patient should be well covered in bed, and steamed with watery vapor, while hot aromatic drinks with laudanum and camphor were administered.¹ Sydenham, Morton, and Young inculcate similar precepts. The modern practice differs in no essential particulars, as may be seen in the following citation from Dr. Gregory's Lectures. During the initiatory fever, "if the circulation be languid, if the pulse be small and feeble, the skin pale, and the extremities cold, if the patient lies on his back, sunk and exhausted, let him have immediately warm brandy and water, cover him with bedclothes, apply mustard poultices to the centre and extremities of the circulating system, and give thirty drops of laudanum, to be repeated in four hours if necessary. This cordial plan of treatment must often be continued for several days."² In measles and scarlet fever opiates are not used to combat symptoms like those just described, but in its stead the more simple and direct stimulants, particularly wine and heat.

Intermittent Fever. Before the introduction of cinchona into medicine, many agents were successively employed for the cure of intermittents, which the specific virtues of bark have led us, perhaps unwisely, to neglect. Of these, opiates were among the most esteemed. They were prescribed either before the paroxysm to prevent it, or during its progress to moderate the severity of the fever. Even since the prevalence of the treatment by bark and its preparations, many of the most eminent practitioners in all countries have recommended that opium should be substituted for or combined with the anti-periodic medicine. Sydenham, Hoffmann, Van Swieten, and Cullen have particularly insisted upon its use, and the last mentioned author has well indicated the conditions for its employment.³ When used before the paroxysm, it should be in the manner prescribed by Sydenham, who directed the patient to be sweated with warm whey four hours before the attack, and upon the first appearance of moisture on the skin, to take a dose of a mixture made with brandy, theriaca, and saffron, and by these means maintain the perspiration for several hours beyond the ordinary time of the attack. In autumnal tertians, this treatment was associated with purgation. Lind has furnished more details than any other writer of the effects of opiates in the hot stage of intermittents, and his large experience enabled him to speak with authority. He declares that opium shortens and abates the hot fit,

¹ BONETUS, op. cit. tom. i. p. 345.

² Lectures on the Eruptive Fevers, Lond. 1843, p. 84.

³ See SCHAERTLICH, cited by BAILLY, for a summary of authorities.

relieving the head, producing perspiration with an agreeable softness of the skin, and often a gentle and refreshing sleep; it also renders the intermission more perfect, and appears to prevent the occurrence of dropsy and jaundice as sequelæ of the disease.¹ Many cases of intermittent fever get well under this treatment alone, or with the addition of a course of vegetable bitters, but those, even, which it fails to cure, may by its means be rendered more amenable to the influence of bark and its preparations. It should, therefore, be more commonly employed than at present.

It is scarcely necessary to remark that opium is sometimes an important corrective to cinchona or quinia, when the stomach is disposed to reject either medicine, and also when they produce diarrhœa. Under these circumstances, it is, indeed, no more than an adjuvant, but even in rendering the valuable services previously described, it acts only as a palliative, and that not so much of essential symptoms, as of those which, however grave they at times may become, are nevertheless incidental, to wit, delirium, ataxia, diarrhœa, &c. If, then, we examine inductively the measure of utility possessed by opiates in idiopathic fevers, we find that it depends almost entirely upon the control which they exert over the disorders of the nervous system, and upon their sudorific virtue, qualities which inherently belong to them. The diseases in question do, in certain stages, permit these qualities to act therapeutically, while at all other periods the exhibition of opiates only tends to aggravate the fever and cerebral disturbance. Hence their proper administration in essential fevers depends altogether upon its opportuneness, and to be safe, or at least efficient, requires the guidance of a cautious and experienced hand.

Inflammation.—If we regard only the phenomena which are essential to inflammation, those, namely, which are strictly local, it may be doubted whether the internal use of opium has any direct power of controlling them; but these local inflammatory symptoms are frequently aggravated and perpetuated by concomitant states of the general system, or by the peculiar circumstances of the diseased organ, and over these conditions opiates in many cases exert a paramount influence, thereby indirectly tending to cure the inflammation. In general terms, their effects may be illustrated by those of rest upon an injured limb; they remove or hold in check causes of irritation, and thus allow the recuperative powers of the inflamed part to act without hindrance. It is in this manner, probably, that must be ex-

¹ An Essay on Diseases, &c., in Hot Climates. Philad. 1811, p. 234.

plained the very unequal, and indeed opposite, effects of opium in the inflammations of different organs, as will be shown in a subsequent paragraph.

Of the constitutional states which exasperate inflammation, and are beneficially affected by opium, none is more prominent than *nervous excitement*. It is shown by restlessness, watchfulness, great susceptibility to external impressions, and to pain, a quick, rapid, and either feeble or hard pulse, and oftentimes a disposition to copious and exhausting perspiration. Such a state is of common occurrence in chronic diseases of all kinds attended with wasting discharges, and especially with hemorrhage or suppuration; in acute affections attended with much pain, or occurring in persons of a strongly marked nervous temperament, or in those whose strength has been impaired by previous disease, the abuse of mercury, narcotics, and alcoholic stimulants, or by unwholesome and scanty food. Intense pain frequently induces a similar condition, a fact which may perhaps account for the great mortality after severe operations. From observing the hurtful influence of the nervous shock after dangerous wounds and operations, M. Malgaigne was led to prescribe in such cases enough opium to keep the patients fully under its influence until the danger of inflammation had gone by.¹ He reports very favorably of the trials he had made of this method, which, to some extent at least, has long been employed by surgeons in this city, and probably elsewhere. Universal experience concurs in recommending that, in acute inflammations of an active form, opiates should be given in full, or sedative doses, and directly after depletion. Their usefulness, when thus prescribed, is doubtless owing, in a great degree, to their preventing that irritability of the system which loss of blood is so apt to occasion, and at the same time retaining the pulse at the point to which depletion had reduced it. To fulfil this indication, the opiate influence must be maintained for a sufficient time.

Hemorrhage.—The remarks made in reference to the antiphlogistic use of opium are in all points applicable to its employment against hemorrhages. Except in so far as it moderates the action of the heart, opium has no direct influence whatever upon sanguineous discharges; its indirect operation, however, is highly beneficial by subduing, as Dr. Chapman expresses it, the mobility of the system which is productive of, or at least is commonly associated with, passive hemorrhages.² In that state, which was more particularly described above

¹ Bulletin de Thérapeutique, vol. xiii. p. 290.

² Elements of Therapeutics, 4th ed., ii. 177.

as an incident of inflammation, and which is equally so of hemorrhage, opium is not only a useful, but an indispensable, remedy; but where loss of blood depends upon plethora, opium must on no account be administered, nor, in the majority of such cases, indeed, is it necessary to interfere at all.

Gangrene.—In all forms of mortification attended with pain, opium may be advantageously employed, but it is in that form of gangrene called *senile*, and which comes on with blackening and shrivelling of the part, that opium has been most valued. In this case, by combining it with tonics and stimulants, the system is enabled to limit and throw off the slough. Percival Pott, who first introduced this treatment, was in the habit of directing two grains of opium to be given to the patient night and morning.¹ Dr. Eberle, in confirming the high opinion entertained by Pott of opium in this disease, remarks that in a case successfully treated by himself the patient took from six to eight grains in twenty-four hours, given in divided doses at intervals of four hours.²

Diseases of the Nervous System.—Pain. The anodyne powers of opium are certainly those which are most frequently invoked and most highly valued, and there is indeed no form of pain to which they cannot afford at least a temporary palliation. But among the disagreeable local sensations which are included in the idea of pain, there are many varieties, particularly the smarting, the burning, the itching, the throbbing, the tensive, and the lancinating, of which the last is more decidedly amenable than the rest to opiate medicines, perhaps because it is, more usually than they are, independent of lesions of structure in the tissues surrounding the nerves which are the seat of pain. In general, opiates relieve pain by blunting the sensibility, whether they do this by acting on the brain or by their direct impression of the nerves of the diseased part to which they are applied; but they also act, in many cases, by moderating the movements of the organ by which the suffering is mainly caused, as in the case of inflammatory affections of the lungs and bowels, the twitching of amputated or injured limbs, the chordee of gonorrhoea, &c. One of the most remarkable facts connected with the use of opiates in painful disorders is that, during extreme suffering, doses of these medicines may be taken with impunity which would under other circumstances be mortal. This is the case in tetanus, some forms of neuralgia, and during the passage of biliary and urinary calculi through the gall-duets and ureters. It

¹ A treatment by opiates and alexipharmics was still earlier employed. Vid. F. HOFFMANN, *De Sphacelo*.

² *Op. cit.*, p. 341.

has been urged, not without justice, that "to stupefy the sensibility to pain, or to suspend any particular disorder of function, unless we can simultaneously lessen or remove the causes which create it, is often but to interpose a veil between our judgment and the impending danger;"¹ but, in regard to pain at least, there are but few cases to which the remark is applicable. In many, opiates aggravate the inflammatory or nervous symptoms, and are therefore not the appropriate means of relieving pain, as in cerebral inflammation or functional disorder with cephalalgia; in almost all others it is certain that the morbid process will not be aggravated by the alleviation of the pain attending it. Wherever pain is the only, or even the best, index of danger, insensibility to it is plainly to be deprecated. Dr. Buek and Dr. Watson relate several cases of strangulated hernia in which opiates were administered under a wrong impression of the nature of the attack, and so effectually lulled the pain as to mask entirely the state of the patients. In one instance the true state of the case was not discovered until too late for the operation to be of service.²

A question of much importance, relating to the use of opium, is thus stated by Dr. W. Griffin, of Limerick: "When a large dose has been administered, and a patient is still suffering intense pain, how long should one wait before it could be considered safe to repeat it?"³ In half an hour, this author thinks, some effect will be observable from a dose of opium capable of affecting the system at all, and perhaps in a few minutes sooner from a solution of the active principles of the drug. But this relates only to full doses of one or more grains; such, in other words, as are sufficient to produce a directly sedative effect. If the pain is periodical, it is better not to wait for the accession of the paroxysm to administer opium, but to anticipate it by an hour or two, in which case one-third of the dose that would otherwise have been required will be found sufficient.

Sleeplessness. The sleep produced by opium is only a higher degree of the anodyne effect of this drug, and in so far, therefore, as pain prevents sleep, or the latter relieves pain, the remarks under the preceding head are equally applicable to the present. But the inability to sleep may depend upon other causes, some of which are far from being well understood, but the most familiar of them are over-excitement of the mind by thought, and that analogous state of morbid mental activity seen in mania, delirium tremens, low fevers, &c. In-

¹ Dr. HOLLAND's Medical Notes and Reflections. On the Use of Opiates.

² N. Y. Journ. of Med., Nov. 1844.

³ Medical and Physiological Problems (London, 1845), p. 191.

somnia accompanying inflammatory disease within the cranium, like pain under the same circumstances, can be neither safely nor successfully treated by opiates; but in all other cases this symptom may be relieved by a treatment of which opium forms the essential part. It is not easy to lay down certain rules for producing a soporific effect by opium; in general, a grain or more must be given if a prompt result is sought for, while a smaller dose, taken several hours before the usual bedtime, will equally well procure a quiet night's rest, after having in some measure displayed its stimulating powers. On the other hand, it sometimes happens that the larger dose is the less sedative, occasioning a restless, oppressive, and unrefreshing drowsiness, which seems to be ever approaching, without merging into, sleep. In such cases the physician is very apt to prescribe a still larger dose of opium on the succeeding night; this Dr. Griffin very justly regards as a serious error, since he has generally found the patient to sleep well on that night without any opiate at all.

Insanity. In the active forms of mania, opiates are rather hurtful than beneficial, especially when there are evidences of a determination of blood to the head. Esquirol disapproves of them in such cases, and is sustained by almost universal experience. Feuchtersleben¹ says, "opium as a soporific, either fails altogether in producing sleep, since in mania the largest doses are often taken without effect, or the patients are more raving than ever when they awake." In some cases of melancholy monomania, where paroxysms of violence are brought on by the perpetual corrosion of some terrible idea, opiates succeed in preserving calm by blunting in some degree the sensibility to mental anguish, but beyond this they exert no curative influence; the moment they are withheld the mischief breaks out anew. Opium may also be used as a palliative in true hypochondriasis, or that form of mental disorder in which most of the delusions relate to bodily ailments; but there also it must be held subordinate to other and more certain remedies.

Delirium Tremens. Since Dr. Pearson's notice of the opiate treatment in this disease (1801), the great majority of practitioners have adopted it unreservedly. Most of them, with Dr. Chapman and Dr. B. H. Coates, declare that "sleep is the *sine qua non* to a recovery" from delirium tremens. The latter gentleman has ably maintained this view in a well-known Essay, in which he lays it down as a rule that "a certain effect is to be produced *coute qui coute*, and we must go on exhibiting opium in considerable doses at such short intervals as

¹ The Principles of Medical Psychology, Sydenham Soc. edition, p. 352.

are sufficient to permit its accumulation in the primæ viæ, until enough has been taken to produce sleep.”¹ Dr. Coates mentions a very severe case which terminated in cure, and in which sleep was not procured until forty-five grains of opium had been given in hourly doses of about six grains each. Such an heroic method would scarcely find partisans since the results of the expectant plan, and of that by alcoholic stimulants, have been distinctly ascertained. Dr. Ware and Dr. Gerhard especially have contributed to place the opium treatment of delirium tremens upon the proper footing. The following summary of an analysis of Dr. Ware’s cases is given by himself: “It appears that of 15 cases in which opium constituted the principal remedy, 6 died; whilst of 54 in which opium was not used at all, or only incidentally and in small quantities, only 5 died. Still further, if we separate from these 54, the 9 cases in which the treatment was eclectic, and in which the mortality seems to have arisen from the combination of acute disease, we have a remainder of 45 cases of which only 2 were fatal. Again, if we compare the mortality of those cases in which opium was pushed to the full extent advised by writers on this disease, with those in which no active remedy was employed, we have a mortality of 1 in 2, against a mortality of only 1 in 29.”² It appears from Dr. Gerhard’s statements that, at the Philadelphia Hospital, Blockley, the mortality from delirium tremens, managed upon the opiate plan, varied between 1 in 8 and 1 in 11, while, after the method was abandoned, it fell in successive years to 1 in 26, 1 in 34, and, finally, to 1 in 160.³

A moderate employment of opium, however, does certainly aid in moderating the violence and abridging the duration of the attack, and the best mode of exhibiting the medicine is undoubtedly to begin with a quarter of a grain, or its equivalent, and progressively to augment the dose by small and hourly additions until sleep is produced, or a sufficient degree of tranquillity obtained. The whole amount of opium thus given should not much exceed what might be safely prescribed in ordinary painful affections; for this cannot be done without great danger, a danger to which no patient should be exposed whose life is not in imminent peril from disease. Such a condition is found in traumatic tetanus, from which few or none recover without active treatment; it does not exist in the disease before us, in which, when uncomplicated, few would perish, although left without medicinal treatment altogether, if proper food and exercise were prescribed.

¹ N. A. Med. and Surg. Journ., vol. iv. p. 214.

² Am. Journ. of Med. Sci., Nov. 1831, and Aug. 1838.

³ TWEEDIE’S Library of Pract. Med., Am. ed., vol. ii. p. 244.

Inflammation of the Nervous Centres. By common consent opiates are discarded from the treatment of acute inflammation of the brain and its membranes; in the decline of the disease, however, and particularly when the antiphlogistic method has been vigorously employed, they are sometimes useful in combating the wakefulness and jactitation which have already been spoken of as calling for these remedies. An epidemic cerebro-spinal meningitis prevailed some years ago in Versailles, Strasburg, Avignon, Dublin, and Vicksburg, Miss., destroying at least two-thirds of those attacked by it. Its prominent symptoms were furious delirium, succeeded by tetanic spasms, particularly of the spinal muscles. The only treatment which appears to have in any degree reduced the mortality of this affection, was that adopted by M. Chauffard, of Avignon, and which consisted in giving large doses of opium from the commencement of the attack.

Convulsive Diseases.—Epilepsy. When this disease arises from organic causes existing within the cranium, or from hereditary predisposition, neither opiates nor any other medicine can be expected to remove it; but when produced by strong mental emotion, or severe bodily pain, the violence of the attacks may be palliated by opiates; they may also be moderated in the same way when their premonitory symptoms are of sufficient duration to permit the influence of a full dose of opium to be established before the convulsive movements. Similar remarks apply to *hysteria*, especially to cases in which the paroxysms are brought on by pain.

Chorea. Sydenham is generally referred to as resting upon opium the treatment of St. Vitus' dance, but in truth he only employed this agent to calm the agitation likely to be occasioned by the repeated bleedings and purgations which he directed. M. Trousseau is, we believe, the only authority in favor of an almost exclusive treatment of certain cases of chorea by opium. His opinion is the more important, inasmuch as it resulted from the treatment of fourteen cases which had proved intractable to other methods, and of which all but one recovered rapidly under the new remedy, which was employed in the following manner: Half a grain of opium was prescribed every hour until the convulsive movements were clearly moderated and some narcotism felt; this state was maintained by increased doses of the medicine during from five to eight days; they were then suspended, and baths directed. After an interval of two or three days, the opium was resumed. In this manner, we are assured that, by the end of a fortnight, it rarely happened that nature was not able to complete the cure.¹ Confined to the class of cases in which M. Trousseau

¹ Op. cit., vol. ii. p. 31.

employed it, this practice is highly deserving of imitation, but in the earlier stages of the affection it should be remembered that other remedies have a stronger claim to confidence, and also that chorea will often get well without any active treatment whatever.

Tetanus. From a somewhat attentive examination of the subject, we have arrived at the conclusion that idiopathic and traumatic tetanus are two distinct diseases, the latter being a functional disorder of the nervous system, and the former, in nearly every case, spinal meningitis. This difference, we are convinced, explains the conflicting accounts recorded of the results of treatment in tetanus. It is in traumatic tetanus that opiates have been most successfully and generally employed, although in ordinary doses they have but little power in controlling the spasms or inducing sleep. As much, even, as an ounce of opium has been taken daily without producing these effects. A part of this singular inactivity arises from the stomach not acting upon the medicine. Mr. Abernethy found in the stomach of a person who had died of tetanus, thirty drachms of undissolved opium, and other physicians record similar cases. These facts ought to dissuade us from administering excessive doses of the drug in tetanus and in other diseases, for, supposing the patient who has taken so much opium to begin to improve, the first effect of his improvement will inevitably be his death from narcotism. The truth is, however, that those who have swallowed such extravagant doses of opium as are mentioned above, without being narcotized, invariably die, while such as have appeared to improve under the opiate plan have experienced its narcotic and antispasmodic effects from *comparatively* small doses.

Opiates should be administered as near the commencement of the attack as possible, and after the bowels have been thoroughly evacuated. They should also rather be given in the liquid than the solid form, for the reason just stated. From thirty to sixty minims of laudanum, or from half a grain to one grain of a salt of morphia in solution, may be directed at intervals of one or two hours, until some sensible impression is produced, or the necessity of augmenting the dose demonstrated. This should be first done by laudanum enemata, and by sprinkling morphia upon the cutis, which ought by this time to be denuded over the upper half of the spinal column. If the medicine still show no tendency to exert a salutary influence, some other had better be tried. If we were obliged to say, with Dr. Thompson, that we "are not aware of any case on record cured by its means," the remarks now made would be superfluous, but there are numerous cases in which the free exhibition of opium, and counter-irritation to the spine, with, it may be, alcoholic stimuli, have cured this terrible

malady.¹ Without attributing the sole credit to the opium in these instances, it formed undoubtedly the essential part of the treatment.

Neuralgia. Opiates have at all times been employed to mitigate the pain of this disease, but they were seldom deemed adequate to its cure, until they began to be applied endermically. The discovery of morphia greatly facilitated this application. About a grain of the acetate or muriate of morphia diluted with powdered gum Arabic may be sprinkled upon a small surface, rapidly blistered by ammonia, or any other vesicant, over the origin, or the most painful point of the affected nerve. M. Trousseau says that in superficial neuralgia so treated the pain rarely fails to be alleviated in a quarter of an hour, and he, as well as Dr. Blakiston, and M. Rougier, of Lyons,² who has made extensive trials of the method, agree with nearly all observers that few even of the most inveterate cases of sciatica long resist this potent remedy applied in such a manner as to maintain its influence for several successive days. It is natural to attribute the efficacy of this treatment entirely to the narcotic employed, nor would any doubt have been felt upon this point, had not M. Valleix undertaken to study separately the counter-irritant and anodyne elements involved. He has shown clearly that in cases of neuralgia cured under the endermic application of morphia, the successful issue is chiefly due to vesication.³

The inconvenience of placing blisters upon the face, so often the seat of neuralgia, and their occasional tendency to leave behind them unsightly scars, may be avoided by a recourse to *inoculation*. This expedient was first suggested by M. Lafargue,⁴ and is thus employed. A solution of about ten grains of the acetate or muriate of morphia in a fluidrachm of water or creasote is prepared, and a small quantity of it is introduced under the cuticle upon the point of a sharp lancet by three or four or more numerous punctures, near the seat of pain. Over each puncture a small papule presently arises, which is soon afterwards surrounded by an areola of about half an inch in diameter, accompanied with some itching and heat. In an hour or two the redness has entirely disappeared; in twenty-four hours the papular elevation scarcely exists, and leaves no trace behind. The advantages of this method in neuralgia of the nerves around the orbit, and especially of those supplying the scalp, are too evident to require any comment. The constitutional influence of morphia is very readily and certainly

¹ See Med. Observ. and Inquiries, vols. i. to v.; CURLING on Tetanus; and Dr. KIRKBRIDE's Clinical Reports, in Am. Journ. of Med. Sci., May, 1835.

² Br. and For. Med.-Chir. Rev., July, 1856, p. 245. Bull. de Thérap., xxiv. 152.

³ Traité des Nevralgies, Paris, 1841.

⁴ Bull. Gén. de Thérap. (1836), xi. 328; xiii. 299; and July and Sept., 1847.

produced in this manner, but its local effects are still more prompt and unequivocal. In many cases it affords instant relief, altogether removing pain which had been incessant and excruciating for several days; in nearly all it greatly mitigates suffering, even upon its first application, and usually requires but two or three repetitions to effect permanent cures even of the most inveterate forms of the disease. Instances are related by M. Lafargue, by M. Jaques, of Antwerp,¹ Mr. Rynd, of Dublin, and others,² of the speedy cure, by the morphia inoculation, of sciatica which had for months and even years resisted all the agents which are commonly employed against this obstinate malady. The positive and concurrent testimony of so many competent witnesses demands for this plan of treatment a more general attention than it appears to have received in this country.

Nervous Headache. A cup of strong coffee containing from a quarter to half a grain of sulphate of morphia, is one of the most efficient remedies for the severe hemicrania which females so often suffer at the catamenial periods. When the pain occurs independently of this cause, or in the male, the remedy is also successful in some instances, particularly if the stomach is not disordered.

Diseases of the Respiratory Organs.—*Pain* and *cough* are the symptoms for which opium is most frequently prescribed in diseases of the chest. There are at least two forms of pain in thoracic affections, the one arising from serous inflammation, and excited by movements of the trunk and even by ordinary breathing; the other produced or aggravated by coughing, and apparently seated in the mucous lining of the air-tubes, or in the attachments of the respiratory muscles. Of these, the former may, it is true, like any other pain, be palliated by opium, but it is much more certainly and speedily removed by depletion and revulsion; the latter, depending almost entirely upon the cough, is mitigated by whatever controls this symptom, and therefore by opium.

Coughing is an instinctive act intended, doubtless, to produce expectoration of the contents of the bronchia, but it is often excessive, more frequent and violent than is sufficient for this end, and sometimes, indeed, has this character when no bronchial secretion exists. By regulating it, therefore, the strength of the patient is preserved, and his comfort promoted. The proper dose of opium for allaying cough should always be less than is sufficient to produce sleep, unless, indeed,

¹ *Annuaire de Thérap.*, 1844.

² *Dublin Med. Press*; and *RANKING'S Abstract*, i. 29; *WOOD*, *Month. Journ. of Med. Sci.*, Feb. 1855, p. 183; *HUNTER*, *Med. Times and Gaz.*, Oct. 1858, p. 457; *BURNS*, *BRAITH. Retros.* (Am. ed.), xxxviii. 37.

the patient is kept awake by other causes than coughing, and that not only because the hypnotic influence is superfluous, but because the constipation of the bowels, and the diminution of the bronchial secretion which opium causes, not unfrequently aggravate the oppression and increase the fever.

Although coughing in most cases requires to be moderated, yet in some, whatever interferes with the act is mischievous, and to this extent must be prohibited. Whenever the weakness of a patient prevents his expectorating freely, or when a superabundant secretion fills the bronchia, opiates increase the danger of suffocation by suspending or restraining the cough. Pituitous catarrh, an affection to which the old and feeble are peculiarly liable, and some cases of phthisis in the last stage, illustrate this remark. Bronchial affections of all sorts in old persons ought to be sparingly treated by opium, for, besides paralyzing the respiratory muscles, it diminishes the secretion of the pulmonary mucous membrane, and consequently renders it more tenacious, and difficult to expectorate.

At the very onset of an attack of *catarrh*, when the symptoms consist merely of some dryness of the nostrils, a little hoarseness, and horripilation, a grain of opium or an equivalent quantity of laudanum, taken upon going to bed, along with a warm draught, will frequently succeed in cutting short the attack. This effect is due, probably, to the stimulant and diaphoretic virtues of the drug, because the same result may often be obtained from a glass of hot lemonade or punch, without opium. It should be borne in mind that too large a dose, instead of dissipating the ailment, will only aggravate it, and produce a painful degree of oppression and constriction of the chest. This treatment, as well as the attendant caution, was first suggested by Dr. Young as the result of his personal experience.¹ In other acute affections of the lungs, opium is useful in the manner already pointed out, or as an adjuvant to antiphlogistic measures. Thus, in *pneumonia* and *pleurisy*, a full dose of opium is used to prolong the sedative effects of depletion, and to promote diaphoresis already favored by the loss of blood. In the former affection, also, it is usefully associated with tartar-emetic to facilitate the tolerance of this medicine when administered with a view to its sedative effects. In *chronic* affections of the lungs, the benefits of opium are almost entirely restricted to its palliative control over the bronchial secretion, the uneasy sensations which excite coughing, and the loss of sleep which it occasions. When the secretion is already scanty, and the cough annoying, opium

¹ Essay on Opium, sect. iii.

should be administered along with ipeeacuanha or squill, or in such other combination as will prevent its desiccative effects upon the bronchial mucous membrane. True *spasmodic asthma*, as was long ago pointed out by Whyte,¹ is very effectually moderated by a full dose of opium, which has not, however, any influence in preventing the return of the paroxysms. In this case the action of the remedy is clearly through the nervous system, and it seems not improbable that it allays the dyspnoea by relaxing the spasm of the respiratory muscles, as well as of the fibres which surround the bronchia.

Diseases of the Digestive Organs.—Pain, vomiting, and purging, with other disordered and injurious movements of the alimentary canal, and excessive secretions from its mucous membrane, are the morbid conditions of this organ, which opiates are adapted to correct. In the various diseases to be passed in review, they occur either singly or combined. *Vomiting*, dependent upon disorder of the stomach itself, and not upon the presence of irritating substances, or upon disease elsewhere to which opium is inappropriate, can very generally be arrested by this agent. Even in gastric inflammation it may be employed after the inflammation has been partially subdued by general or local depletion, although the attack may have been owing to the action of irritant or corrosive poisons. These substances must of course be previously evacuated, and diluent and mucilaginous liquids, in moderate quantities and at a low temperature, prescribed. But it is against vomiting excited sympathetically by disease of other abdominal viscera than the stomach, and in the uninflamed but morbidly sensitive states of this organ itself, that opium is most effectual, as in peritonitis, obstruction of the bowels, and certain forms of dyspepsia. Oftentimes it happens that the opiate is not long enough retained to produce its effects, in which case, it may be introduced by the rectum, or, by the endermic method, be applied to the epigastrium.

Gastralgia. Neuralgia of the stomach is generally described as a symptom of dyspepsia, or as by Cullen under the name of pyrosis, or water-brash. By this physician and by Chapman it is attributed to debility of the stomach, arising from a meagre and penurious mode of living, and by others, to an exclusively vegetable diet, as of oatmeal, or the brown bread, which the continental peasantry of Europe chiefly consume. Amongst ourselves the substitution of tea and coffee for animal food is a fruitful source of this painful and alarming disorder. As Dr. Chapman remarks, cases of painful dyspepsia are

¹ Observations on the Nature, &c., of Nervous, Hypochondriac, or Hysterie Disorders, 2d ed., p. 491.

often met with "among the wealthy and luxurious." It in fact depends upon general nervous disturbance, as well as upon local causes of indigestion, and is a frequent complication of hysteria, hypochondriasis, exhaustion by bodily or mental fatigue, sensual excesses, depressing emotions of the mind, and that state of nervous excitability which anæmia, chlorosis, and even pregnancy, sometimes generate. But, whatever may be its cause, opiates are equally important in its cure, the salutary effects of the drug being of course greater or less in proportion to the more or less simple and uncomplicated nature of the attack.

The pain and vomiting, which are the prominent symptoms of gastralgia, are usually excited by the presence of food in the stomach, and come on at variable periods after meals. In the less severe cases, a small quantity of opium, as one-quarter of a grain, taken immediately before eating, will generally prevent the attack; or a solution of one grain of the acetate of morphia in an ounce of sweetened water may be taken on the first sensations of pain, and continued, in divided doses, at intervals of ten minutes, until some effect is produced. When the disease is more violent, the dose must be augmented in the same degree, and, if the pain is prolonged, morphia should be applied to the denuded skin of the epigastrium.¹ It must not be forgotten that the gastric pain is only one symptom of the disease in many cases, and that a more wholesome diet, exercise, excitants of the skin, quinine, iron, and above all mental diversion, are requisite to confirm the cure.

M. Bouehardat² furnishes an explanation of the *modus operandi* of opium in this disease, which, if not applicable to all cases, is at least ingenious. He attributes all the symptoms to an excess of the gastric juice, which fluid he alleges to have but a small share in the digestion of vegetable substances, and which thus, on reaching the duodenum, neutralizes the pancreatic juice and prevents the digestion of amylaceous matters. Opium, according to this author, diminishes the secretion of gastric juice, and of course prevents the mischiefs which result from its excessive quantity. It is a sufficient disproof of this, as an exclusive theory, that in not a few cases of gastralgia the fluid rejected from the stomach is quite insipid.

Diarrhœa. Of acute attacks of diarrhœa there are two principal varieties, in which perhaps opiates are not equally appropriate; in the first there is an excessive secretion of fluids into the intestine, arising from the impression of cold upon the cutaneous surface, and in the

¹ SANDRAS, Bull. de Thérap., xxiii. 84; VALLEIX, *ibid.*, xxvii. 31; SAINT MARTIN, *ibid.*, xxxvii. 78.

² Annuaire, &c., 1846, p. 7.

second undigested food or some other irritant provokes the increased action of the bowels. As a general rule, the former may be successfully combated by opiates alone, while the latter more commonly requires that the irritating substances be previously evacuated by a laxative. The presence of undigested food in the dejections is, however, by no means a contraindication to opium; in the chronic forms of diarrhoea, this circumstance is due to the morbid irritability of the bowels, which hurry the aliment through them without its being assimilated. This condition, as much as any other, demands imperatively the use of opium for its cure. Even where the cause of diarrhoea is beyond the reach of opiates, these agents are still beneficial in moderating the discharge, as in the colliquative flux of phthisis. In these cases enemata of laudanum and the endermic use of morphia are, in general, preferable to opiates given by the mouth, which are more apt to enfeeble the digestion. If they have not this effect, they should be combined with astringents, and of such combinations none is superior to opium and acetate of lead. In the chronic forms of diarrhoea which are independent of constitutional disease, many authorities regard a combination of calomel with opium as superior to that just mentioned. Eberle states that he has repeatedly put a permanent stop to chronic discharges from the bowels by exhibiting a quarter of a grain of opium, with one-eighth of a grain of calomel, every four hours. This treatment is peculiarly appropriate to the chronic form of the affection next to be considered.

Dysentery. It would be a fruitless labor to attempt to judge of the value of opium, and the method of employing it in dysentery, from what has been written on these subjects, were no reference made to the forms of which the disease is susceptible. Some authors have founded their opinion upon the effects of opium in sporadic dysentery, and the greater number upon their experience with this agent in various epidemics of the disease, many of which differed in type as widely as others in geographical position, as far, indeed, as the East is from the West. Thus, while Dr. Christison¹ declares that severe epidemic dysentery may be cut short in the early stage by opium, given boldly and often, and Dr. Chapman² says that, deprived of the aid of opium, he should really not know how to proceed in the treatment of the disease, Cullen³ maintains that, "notwithstanding the urgency of the pain, it is at best a very precarious remedy, and to be avoided as much as possible;" and Twining, mingling theory and experience, remarks: "When we remember the actual condition of the local dis-

¹ Month. Journ. of Med. Sci., i. 90.

² Op. cit., ii. 179.

³ Op. cit.

ease which is to be cured before we can remove acute dysentery, we shall hold opiates in great contempt. I have very often seen opium exceedingly injurious by masking the most deadly symptoms until the patient was past recovery."¹

Nothing can be plainer than that these authors must have observed and treated dysentery under such opposite circumstances as to prevent their results from being comparable with one another. Baillou,² and after him Sydenham, dwell upon the error of applying one treatment to all epidemics of dysentery, yet the authority of the latter is constantly appealed to in favor of an opiate treatment which he never prescribed. Before his time the treatment of the active stage of the disease was composed of evacuants, and in its decline astringents were administered, with an occasional dose of some opiate preparation by the mouth or rectum. Sydenham established the more methodical plan of using evacuants and opiates on alternate days, and depended upon the latter exclusively in mild sporadic cases. His reasoning, like that of nearly all physicians both before and since, was, that the contents of the bowel must first be removed, lest the anodyne should augment the evil by retaining them. Hence, whether, with Zimmermann,³ Young,⁴ Pemberton,⁵ Eberle,⁶ Thompson,⁷ and the great majority of experienced writers upon dysentery, the primary dependence is placed upon laxatives, or whether, with Moseley, emetics and sudorifics are preferred, opiates are nevertheless indispensable for allaying tormina and tenesmus, promoting sleep, and favoring the action of the skin. "The real use of opium," says the author last mentioned, "is to arrest the hurry of the disease: to procure time to put some rational method of cure into execution, to take off the irritating property of other medicines, and to give them their intended effect."⁸ Annesley, having the same object in view, prescribed large doses of opium with calomel in the forming stage of the disease, and as long as feculent matter appeared in the stools, and afterwards opiate enemata.⁹

In mild attacks of dysentery there is no doubt that opium alone, or that purging alone, will effect a cure, but it is equally certain that rest,

¹ The Diseases of Bengal (Calcutta, 1832), p. 16.

² "Prout variæ sunt dysenteriae, ita variare remedia oportet. Nee, quemadmodum multi faciunt, quasi eundem soccum et cothurnum omnibus aptantes, oportet eodem modo curare omnes dysenterias a quacumque causa ortæ sint."—Baillon, Op. Om., tom. iii. p. 215.

³ Traité de la Dysenterie, chap. vi.

⁴ Op. cit., p. 50.

⁵ Diseases of the Abdominal Viscera (London, 1820), p. 146.

⁶ Loc. cit.

⁷ Ibid.

⁸ A Treatise on Tropical Diseases, 4th ed. (London, 1803), p. 257.

⁹ Diseases of India (London, 1828), ii. 272, &c.

diet, diluent drinks, and emollient clysters will have the same effect; but, when the disease is severe, no exclusive plan can be relied upon, and least of all, perhaps, that by opium. The violence of the malady must be broken by depletion, emetics, laxatives, or diaphoretics, according to the type assumed by the case under treatment, and the epidemic constitution, after which, or alternating with which remedies, the "matchless power of opium" may be invoked for perfecting the cure. Even under these circumstances we would follow the advice of Pringle, and prescribe opiates at first in small doses, a quarter or half grain every three hours, or a corresponding dose of laudanum by injection. This, it will be understood, is in addition to the portion of laudanum which it is proper to add to each dose of purgative medicine administered, in order to prevent its griping. In the more advanced stages of dysentery, when the affection has become stationary, or tends to pass into the chronic form, opiates are not less valuable than before, and are most effectually given in combination with astringents, or, as before stated, in conjunction with small doses of calomel.

Chronic dysentery is materially benefited by opiates. They moderate the action of the intestinal canal, reducing the number of dejections, alleviating pain, preventing the food from passing too rapidly through the bowels, and at the same time prolonging the contact of the astringent, balsamic, or other similar agents employed with the diseased surface of the intestine. Hence opium, without being essentially curative in chronic dysentery, is invaluable as an adjuvant to other remedies.

Cholera. In the *sporadic* form of this disease, no other remedy resembles or even approaches opium in efficacy. It was formerly thought necessary to precede its administration by a free evacuation of the stomach and bowels; for the vomiting and purging which belong to the disease were held to be evidences of a salutary effort on the part of nature, which it was the duty of the physician to encourage. But a truer observation taught that these operations, instead of being critical, are essentially morbid, and experience demonstrated that the speediest method of arresting them is the most direct road to the patient's cure. It is now very generally admitted that opium affords the surest means of gaining this object. A grain should be taken every hour, or every half hour in severe cases, and the patient, meanwhile, prevented, as far as possible, from drinking. Enemata should also be administered containing from twenty to forty drops of laudanum. Or, if the thirst cannot be allayed by rinsing the mouth and throat, small quantities of iced water or lemonade, or fragments of ice, may be swallowed. But the patient should understand

that the rapidity of the cure depends in a great measure upon his firmness in resisting his instinctive craving for fluids.

At whatever stage the affection may be, there is an equal propriety in administering opiates. Should the vomiting and purging be so incessant as to cause the rejection of the opiates prescribed, the cuticle should be removed from the epigastrium, and a grain or two of a salt of morphia sprinkled upon the denuded skin. A better plan is that proposed by MM. Lesieur and Lembert, which consists in reducing the salt to a paste by means of a few drops of water, and spreading it upon a piece of oiled silk, which is then applied over the raw surface. When the anodyne influence is fairly manifested, the plaster should be removed, and the particles adhering to the skin washed away, in order to prevent an unnecessary or dangerous degree of narcotism. A sufficient effect is usually produced in half an hour.¹ In the sporadic form of cholera, however, although opium is truly curative, and beyond all price as an alleviator of pain, it cannot be said, in all cases, to form a necessary part of the treatment, for the disease is very rarely fatal when it attacks persons in good health. Under these circumstances, the urgency of prescribing opium is not great enough to outweigh any important contra-indications to its employment that may exist. When the constitution is naturally feeble or impaired by previous disease, the remedy is more important, since it may then become necessary for the preservation of life.

In *epidemic cholera* the efficiency of opium is no better established than that of the greater number of remedies employed against this fatal malady. There is no evidence whatever that it is beneficial in very severe cases, and scarcely any of the manner in which it exerts its influence upon those of a milder type, of what symptoms it palliates, or how far it shortens the duration of the disease. Unquestionably opium has prevented the development of many a case of Asiatic cholera, by subduing those premonitory symptoms which have received the name of *cholerine*; for this purpose, indeed, its value is very great, yet not so much so as to exceed that of camphor with aromatic and diffusible stimulants, and mild astringents. If the records of treatment in the fully formed stages of cholera are examined, it will be found that opium was depended on in a very small number of cases indeed; that so far from being administered in larger quantities than are given in the sporadic affection, as might have been expected from the superior gravity of the epidemic disease, it was actually prescribed

¹ *Compendium de Médecine Pratique*, par MM. DE LA BERGE et MONNERET. Paris, 1837, ii. 234.

in fractional doses, and associated with more active medicines; and that, for anything that appears to the contrary, it might have been safely omitted from the treatment of the graver forms of Asiatic cholera.

All experienced physicians of adequate authority, agree in dissuading from the use of opium in the active stages of *cholera infantum*. It is not logical to ground this advice, with Eberle, upon the "strong tendency to cephalic affection" which characterizes the disease; the objection to opium rests upon the much more solid foundation of direct experience, and the young practitioner ought to acknowledge its force, when he feels tempted by the vomiting and purging of his infant patients, to prescribe for them a remedy which is so efficient in relieving analogous symptoms in the sporadic cholera of adults. Dr. Hallowell, of this city, who has furnished by far the most complete history of the disease in question, confirms the opinions of Dewees, Drs. Condie, J. F. Meigs, and others, and recommends extreme caution in the use of opiates in the first, and indeed, all stages of cholera infantum.¹ If used at all, opium should be given in the form of Dover's powder, and in the dose of a quarter or a half grain, with an equal quantity of calomel, every three or four hours. In the chronic form of the affection opiates are more appropriate, and are then most advantageously associated with mild astringents. The efficacy of opium in the first, and its want of curative power in the two other forms of cholera now mentioned, lend a strong support to the opinion which has been maintained upon other grounds, that in the latter there is an additional morbid element which, in spite of a similarity of symptoms, creates an essential distinction between them and sporadic cholera morbus.

Colic. This term does not properly designate a disease, but the symptom of griping pain, merely, which is common to several distinct affections; to that condition which precedes diarrhoea occasioned either by cold or by acerb fruits, or sour drinks; to those several forms, so different in gravity, of obstruction to the bowels by simple constipation, by stricture, by invagination, and by hernia; to the painful passage of a gall-stone through the excretory ducts of the liver; and even, according to general usage, to a like impediment in the ureter. Still another variety of colic, that of painters, may be added to the preceding, although, by most medical writers, at least, it is described as an independent disease. In affections so different in nature and severity, it is plain that the efficacy of opium must be extremely various, even in relation to the element pain which is a prominent symptom in all of

¹ Am. Journ. of Med. Sci., vol. xiv. p. 46.

them. Here, as elsewhere, the treatment cannot be rational while the diagnosis is obscure, and the extent to which opium may be used to alleviate pain in such affections depends upon how far it is likely to interfere with the other means employed with a more direct aim at removing the cause of suffering. In those attacks depending upon acrid ingesta or fæcal accumulations, they may be prescribed along with, or even before, cathartics; in painters' colic they should alternate with purgatives; and when the attack arises from cold, or from the passage of a biliary or renal calculus, they may be given alone. In each case the dose must, of course, be proportioned to the violence of the pain. Testimony is not wanting to prove that in painters' colic opiates may be depended upon almost exclusively for curing the disease. Dr. Luckey reported, many years ago, that he was in the habit of prescribing ten grains of opium every hour until two scruples were taken, and with such effect that a mild laxative was then sufficient to open the bowels. This heroic treatment is vouched for by Eberle as having been literally and very successfully employed.¹ When the source of the symptoms is a mechanical displacement of a portion of the intestine (invagination, hernia), no good purpose can be answered by larger doses than are just sufficient to mitigate suffering; in external strangulated hernia, mischief may arise from producing a full narcotic effect, for the patient may appear to be at ease while the strictured bowel is becoming gangrenous. Cases illustrative of this unfortunate occurrence have been reported by Dr. Watson and Dr. Buck, of New York.²

Peritonitis. Dr. Graves, of Dublin, was, it is believed, the first person to show the curative powers of opium in peritonitis produced by the operation of paracentesis. He was led to employ this agent as a sedative in large doses, because the patients operated upon were too feeble to bear depletion. Subsequently, he cured by the same means, an attack of peritonitis excited by the opening of an hepatic abscess. In another instance a boy with *enteritis* was suddenly seized with symptoms of peritoneal inflammation, which were subdued by large doses of opium. The ensuing constipation was treated by exhibiting an aperient, when the symptoms returned, and the patient died. A small perforation was found in the *cæcum*, and the intestines were agglutinated in the *left iliac fossa*. On a subsequent occasion a man who had taken an overdose of Glauber salts, presented the signs of peritoneal inflammation; he was in like manner treated with opium, and recovered.³ Dr.

¹ Elem. of Therap., p. 337.

² N. Y. Journ. of Med., Nov. 1844.

³ Med.-Chir. Rev., xxviii. 541, and xxxv. 157.

Griffin, of Limerick, relates one case of alleged peritonitis from intestinal perforation, in which a girl had gorged herself with gooseberries and currants, and another, of a boy who was only seen "in the last stage of typhus fever." Of the latter, Dr. Griffin cautiously remarks, "the symptoms seemed in a degree to indicate perforation," and again, "the suspicion of perforation having occurred would appear somewhat probable."¹ Both patients were rescued from the very grasp of death by large doses of opium.

None of these cases, it will be observed, is an unequivocal example of intestinal perforation in typhoid fever; but several of them demonstrate the marvellous powers of opium in arresting peritonitis from division of the abdominal serous membrane, and its control over the symptoms of that disease in certain other dangerous conditions. Very few instances, indeed, are on record in which the signs of perforation in an undoubted case of typhoid fever disappeared under the use of opiates. One is recorded by Louis.² Instead, however, of giving, like Drs. Graves and Stokes, a grain of opium every hour, he attained his object by administering a grain and a half of muriate of morphia in the course of every twenty-four hours. Such caution is not, however, essential, for the first-named gentlemen expressly state that their large doses gave rise to no unpleasant effects. Several examples similar to this one might be adduced, in all of which there was a strong presumption of peritonitis produced by perforation of the bowel. But as it is now certain that peritonitis may occur as a complication of typhoid fever merely by an extension of inflammation from the bowel, without perforation of its coats, the precise degree of usefulness of opium in such cases is still undetermined.³

The preceding remarks are intended to show that the success usually ascribed to opium in peritonitis from intestinal perforation is somewhat exaggerated; but they at the same time prove conclusively its value in at least analogous conditions, and therefore encourage its use in other forms of peritonitis, and enjoin it peremptorily in that which has hitherto resisted every other plan of treatment. Its curative action, under the circumstances we are considering, is, doubtless, owing to its retarding the peristaltic movements of the intestines, and its influence ought therefore to be promoted by the patient's

¹ Med. and Phys. Problems, p. 20.

² *Fièvre Typhoïde*, 2ème éd., ii. 449. M. Louis admits that the character he assigns to this case is only in the highest degree probable, not absolutely certain.

³ Compare Phil. Med. Exam., N. S., x. 120; N. Y. Journ. of Med., N. S., ii. 330; Transactions of the College of Physicians of Philadelphia, N. S., ii. 338, 351.

remaining perfectly still, and living upon the least possible amount of food.

Opium has been employed by many practitioners in *puerperal peritonitis*, as an adjuvant to depletion and mercurials, but it was originally proposed in 1843, and has recently been advocated by Dr. Alonzo Clark, as an exclusive remedy in this disease. Dr. C. is careful to distinguish the cases in which it is indicated from those in which the leading element is purulent metritis. In the latter, however, it is believed in some degree to control the inflammatory element. According to Dr. C. this is the most efficacious medicine that has yet been proposed for puerperal peritonitis. But, in order to obtain its curative effects, its use must be commenced early, and the patient brought under its influence as rapidly as the susceptibility of his system can be ascertained by trial. "The tolerance of opium," says Dr. Clark, "in some cases of puerperal peritonitis, almost surpasses belief. Yet in private practice I have not found more than half or two-thirds of a grain of sulphate of morphia every two hours necessary." "The influence of the opium," it is added, "should be kept up till the pain and tenderness subside, the tympanitis diminishes in some degree, and the pulse falls below 100; then, with the concurrence of other symptoms, it should be gradually diminished, and at length discontinued."¹ The value of this method is still undetermined, for, as far as we can learn, the example of its sagacious proposer has not yet been imitated. The general impression appears to correspond with that expressed by Richter many years ago, that nearly all observers agree in regarding puerperal peritonitis as a disease requiring great circumspection in the use of opiates.²

Diseases of the Genito-Urinary Organs.—The utility of opium in large doses in relieving *nephritic colic* has already been spoken of; it is not less useful when calculi exist in the pelvis of the kidney or the bladder, or when chronic catarrh is the cause of pain. In *spasm of the urethra* it is, next to the warm bath, the most efficient remedy; combined with camphor, it diminishes the severity of gonorrhœal *chordee*, or prevents this painful accident; it palliates the scalding of the urine and the burning pain of inflammation of the urethra and vagina; no other remedy, except the anæsthetics, so well allays the exhausting "grinding pains" which frequently precede labor, and none so effectually prevents threatening *abortion* when it depends upon any cause which does not render the premature expulsion of the ovum inevitable. Perhaps the most common accidental cause of miscarriage is over-ex-

¹ N. Y. Journ. of Med., March, 1855, p. 304, and Jan. 1858, p. 82.

² Ausführliche Arzneim., ii. 639.

ertion; and its effects can nearly always be prevented by the timely and liberal use of opiates. In the cases now mentioned, enemata are preferable to any other means of introducing opium into the system; they carry the remedy near to the seat of the disease, and spare the stomach much of that disorder which it is apt to occasion when taken by the mouth. The amount proper to be given can only be measured by the effects produced, which are very dissimilar in different persons. It is well to commence with a full dose of from thirty to sixty drops of laudanum, and repeat it from hour to hour until the narcotic influence is well developed or relief is experienced.

Venereal Disorders. The preparations of opium have long been used to a greater or less extent for palliating the pains of secondary syphilis, but it was reserved for Mr. Grant, an English army surgeon in New York, and Michaelis, head physician of the Hessian mercenaries employed by the British during our revolution, to propose this medicine as a specific against venereal, and for a time to bring over to their opinion a number of practitioners in Europe and in this country. The practice was to give a grain of opium morning and night, increasing each dose daily by one grain until the symptoms abated. These doses generally procured copious diaphoresis, and relief from pain. But the comparative experiments of Pearson,¹ and the trials of John Hunter,² showed conclusively that the anti-syphilitic virtues attributed to opium were quite illusory. In one case, Hunter administered seven hundred and sixty-eight grains of opium in twenty-six days. Before the publication of the American views, he had been in the habit of employing opium with great advantage as a local application to irritable primary and secondary sores, and as an internal remedy to persons affected by them. The latter method is now very frequently pursued when the pains in bones are violent, or the patient is of a nervous temperament. "In primary syphilis opium is an important adjuvant to mercury, especially in females and other excitable persons, but it should in no case be regarded in any other light than as a sedative and palliative, and ought not to be permitted to usurp the place of those true anti-venereal remedies whose character has been established by the experience of ages."³

According to Dr. Chapman,⁴ it was the practice of the late Dr. Kuhn to treat *gonorrhœa* exclusively by a grain of opium morning and night, a plan which he found, on the whole, more successful than

¹ DUNCAN'S Med. Commentaries, xvi. 217.

² HUNTER on the Venereal. Complete Works, Am. ed., p. 308.

³ LAGNEAU, Traité prat. des Mal. Syphil.

⁴ Op. cit.

any other in managing this troublesome complaint. Dr. Lyons, of Philadelphia, is also said to have cured an obstinate and severe gonorrhœa by opium alone.¹ So far as we know, these are the only practitioners who have attempted so simple a cure of gonorrhœa, and the fact is mentioned for the purpose of inducing others to give it a sufficient trial.

Diabetes. Opium is superior to any other single medicine in diminishing the quantity and the saccharine quality of the urine in this disease, and it has entered more or less into the treatment prescribed for diabetes by Aetius, Sydenham, Willis, Darwin, and, in our own time, by Rollo, Warren, Prout, Elliotson, and others. By most of these physicians it was associated with astringents, and, since the experiments of Rollo, with an almost exclusively animal diet. The efficacy of opium in diabetes appears to depend upon its being administered in full and progressively increasing doses until a partial tolerance of the drug is produced. Under these circumstances there can be no doubt that it frequently appeases the hunger and thirst which are so tormenting in this disease, that under its influence a smaller amount of urine and less charged with sugar is secreted, that the skin becomes more pliant, and that, consequently, the flesh and strength are less rapidly wasted, while the mind yields less readily to despondency.

Dr. Ferriar, who employed opium in conjunction with cinchona, uva ursi, lime-water, and animal diet, states that out of thirteen cases of which he had preserved the minutes, ten were cured, and two much relieved.² On examining the thirteen cases reported as examples of diabetes mellitus, in Dr. Ferriar's medical histories, the degree of success claimed by him appears to be singularly exaggerated. There is only one case out of the thirteen which gives unequivocal evidence of its cure, for the subject of it is reported as being in good health four years after he had been under treatment. Yet, even of this case, it is not explicitly stated that the urine was saccharine. Out of seven of the remaining cases, two are said to have relapsed, two are reported as having died while under treatment, two as improved, and one as not improved. It is evident that Dr. Ferriar's statement was made without any direct reference to the written record, and like most others of similar origin, was very wide of the truth.

Diseases of the Organs of Locomotion.—Rheumatism. Muscular rheumatism may sometimes be cut short by a full dose of opium

¹ DUNCAN'S Med. Com., x. 154.

² Medical Histories and Reflections. (Phil. 1816), p. 453.

administered soon after its invasion, or still better, by a corresponding quantity of Dover's powder. These remedies act by producing copious diaphoresis. In acute articular rheumatism, it has generally been used to allay pain, but in 1839, Dr. Corrigan, of Dublin, communicated the very favorable results he had obtained by employing opium in this disease, as an almost exclusive remedy, and in very large doses.¹ He regards the practice commonly pursued of giving a grain of opium every fourth or sixth hour, as quite inefficient, and as rather injurious than otherwise, by its stimulating influence. To produce a decidedly sedative and curative effect, a grain of opium must be given every hour or two until the patient feels relief, and the impression is then to be maintained at the same point throughout the attack. Under these circumstances it neither disturbs the brain, nor confines the bowels, but, according to Dr. Corrigan, lessens the patient's suffering, restores his strength, shortens the disease, and prevents complications about the heart. These recommendations are very strong, and if sustained by the continued experience of Dr. Corrigan, and of other physicians, ought to influence and modify the customary plan of treating acute rheumatism. So far as we know, however, the opiate method has not been fully tested in any quarter, and the objections made to it rest almost entirely upon conjectural grounds. Dr. Sibson, indeed, has employed this plan of treatment, but although the patients manifested an extraordinary tolerance of the opium, the proportion of those who presented cardiac complications was quite as great as under other methods.²

Eberle advocates large doses of opium in inflammatory diseases, as less stimulant than small ones, and says that in rheumatism he has, after proper depletion, given as much as four and five grains for a dose, and with most favorable results,³ but it does not appear that he sustained the opiate impression throughout the attack. He also, in another work, quotes Cazenave as saying, that the timidity with which this narcotic is usually administered in acute rheumatism, is the cause of its frequent failure in doing conspicuous good, and as recommending a grain of opium to be given every hour, "till a complete calm is established, or an abundant perspiration induced."⁴ Dr. Christison regards bleeding as an essential preliminary to the opiate treatment in acute inflammatory rheumatism. But, it may be remarked, he administers opium in the form of

¹ Med.-Chir. Rev., Jan. 1840.

² RANKING'S Abstract (Am. ed.), xxvii. 33.

³ Op. cit., p. 329.

⁴ Practice of Medicine. (Phil. 1831), vol. i. p. 378. The date of this statement, it will be observed, is several years anterior to that of Dr. Corrigan's reports.

Dover's powders, given in ten grain doses every half hour until half a drachm is taken, so as to produce a copious diaphoresis, which is to be kept up for thirty-six or forty-eight hours, by means of warm drinks. This is a somewhat different mode of action from that which has been considered, and to be successful, doubtless requires that the opiate should follow depletion.¹ On the whole, it seems probable that where pain is the principal element of acute rheumatism, the cure may be intrusted to opium during the early stages, and to this remedy combined with tonics at a later period; but where the febrile reaction is, at the first, intense, the arterial excitement should previously be moderated by venesection.

MM. Trousseau and Bonnet present an interesting narrative of the treatment of articular rheumatism by the endermic application of the salts of morphia.² They produced small blisters with ammonia over every affected joint, and dressed them twice a day with muriate of morphia. Their observations led them to conclude that the influence of these remedies was chiefly local, for while they relieved the pain, in acute rheumatism, they did not prevent the disease from migrating from joint to joint. Cases in which it was more fixed in one or several articulations, and had passed the inflammatory stage, were found to be more amenable to the endermic treatment.

Gout. It is pretty well agreed amongst practitioners of the present day, that the pain attendant on a fit of the gout may, and ought to be, modified by opium, prescribed as a palliative merely, and not at all to supersede remedies which influence more directly the violence and the duration of the disease. To lessen the anguish of gout, however, opium must be given on the approach of the paroxysm, in doses quite as large as were recommended for acute rheumatism, and repeated at even shorter intervals. Seudamore strongly recommends this treatment, and strikingly illustrates its utility. The wine and vinegar of opium are, perhaps, preferable to the solid drug, in consequence of the aromatic ingredients they both contain. In retrocedent gout attacking the stomach, opinion in favor of opiates is still more unanimous. They can, indeed, be hardly dispensed with, and must be given boldly and often. The liquid preparations just mentioned should be administered every half hour in the dose of sixty drops of the former, or thirty of the latter, as minimum quantities, to be rapidly increased if the urgency of the symptoms demands it. At the same time the patient should be plied with diffusible stimulants, which will promote

¹ Edinb. Month. Journ., Feb. 1841.

² Archives Générales de Médecine, tom. xxvii. and xxviii.

the object in view, and permit a reduction in the dose of the opiate, as well as its earlier suspension.

As a Local Remedy.—Several of the more important examples of the local uses of opium have already been pointed out, under the head of neuralgia, tetanus, rheumatism, &c., it may now be added that liniments and poultices containing opium or its preparations, are in constant use as local anodynes, although their efficacy is much inferior to that of the salts of morphia applied to the denuded cutis. As a dressing to irritable and unhealthy *ulcers*, a watery solution of opium is soothing; in granular *conjunctivitis*, with or without ulceration of the cornea, the wine of opium may be used with advantage; in *ear-ache*, a few drops of laudanum mixed with warm sweet oil, may be introduced into the auditory meatus; in *toothache*, from caries, the pain is often palliated by a strong solution of a salt of morphia on a morsel of cotton placed in the cavity, and in other forms of odontalgia frictions of the gum at the affected part, with any concentrated opiate preparation, or its inoculation by numerous punctures, will frequently be followed by an entire relief from suffering. In *paronychia*, an affection second to none for severity of pain, it is highly probable that this very symptom tends to augment the vascular injection of the part, and the degree of suppuration which follows. It is, at all events, certain, that when attacked in the forming stage with strong opiate fomentations applied without intermission, the further progress of the affection is often completely checked, and a resort to the knife, which is so justly dreaded by the sufferer, averted.

ANTIDOTES.—As opium and its preparations produce narcotism, in so far only as they are absorbed, and as no chemical reagent is known by means of which the active principles of the narcotic can with certainty be rendered insoluble in the stomach, there remain no other modes of procedure, when a poisonous dose of opium has been swallowed, than to remove it from the stomach, and then, if its constitutional effects appear, to combat them by means of stimulants addressed to the nervous system. The primary indication which has been mentioned is often difficult of fulfilment, for the nervous system is already benumbed, when medical aid is sought, and the emetics which operate by direct contact with the extremities of the nerves concerned in the act of vomiting, no longer produce this result, or only the more powerful among them, and in very large doses. In mild cases, and when the drug has been very recently taken, a dose of ipecacuanha will generally suffice to procure its rejection, or copious draughts of tepid water containing mustard or salt may answer the same purpose. If these fail, sulphate of zinc, in doses of from one to two

scruples, should be given, and, if the stomach still refuse to act, ten or fifteen grains of sulphate of copper may be administered. Dr. Beck¹ observes that sulphate of copper and tartar emetic are not always safe remedies in narcotic poisoning, for, if retained in the stomach, they may themselves produce dangerous inflammation of the digestive tube. This objection is not valid as regards sulphate of copper, and in the case of tartar emetic its sedative operation is so powerful that it should be excluded from the ordinary treatment of narcotic poisoning.

Dr. Thompson objects to the practice of administering diluent drinks as dangerous, in consequence of their spreading the narcotic poison over a larger surface, and thus promoting its absorption. This opinion, which does not appear to be deduced from any observation of the bad consequences of the method, may be met by the argument that whatever mischief the fluid tends to cause by diffusing the poison, is probably counterbalanced by the corresponding diffusion of the emetic substance, which thus acts more promptly, and less painfully. The emetic action may be favored by tickling the fauces with a feather, or with the finger, as well as by the several means adapted to arouse sensibility, which will presently be pointed out. Enemata containing about a scruple of tartar emetic have occasionally succeeded in procuring emesis, when medicines given by the mouth have failed to do so, or when the patient has obstinately refused to take them.² The clysters should be very large, and introduced as high as possible into the bowel, by means of an œsophagus tube. Tartar emetic, in the dose of one grain, and dissolved in water or whey, has been successful in producing emesis on being injected into a vein of the arm, after all other means of attaining this object had proved ineffectual.

Although, as before remarked, there is no specific antidote to the preparations of opium, yet when a large quantity of the poison has been swallowed, it may be well to administer the *ioduretted water* of Bouchardat,³ which is composed of one grain of iodine, two of iodide of potassium, and a pint of water. A solution of tannin has also been proposed with a view of precipitating the active principles of the poison, but we are not aware of its ever having been employed.

If the means now recommended do not cause free vomiting, or the stupor is so profound as to prevent their use, the *stomach-pump* should be resorted to without delay, and the stomach so thoroughly cleansed with warm water that what is withdrawn gives no evidence of foreign

¹ Med. Jurisprudence, vol. ii. p. 586.

² Dr. Roe, Am. Journ. of Med. Sci., Feb. 1831.

³ Annuaire, &c., 1845, p. 12.

intermixture of any kind. But when opium has been swallowed in mass, the attempts to procure emesis should be renewed after a sufficient trial has been given to the stomach-pump.

After the foregoing measures have all been faithfully employed, the constitutional effects of the opiate remain to be combated, and with a vigor proportioned to the want of success which has attended the previous treatment, as well as to the degree of narcotism present. The remedies for this state all consist in stimulants of the nervous system, acting either directly upon its great centres, or indirectly by exciting the respiratory function. Some of them are applied internally, and others externally. Of the former, the best, and indeed the only one, which merits confidence, is *coffee*. It should be made strong, and given with little or no sugar, which, according to Bouchardat, delays its absorption, and lessens its power. This author advises that a small quantity of brandy be added to each dose.¹ Dr. Fosgate, of New York, who accidentally took an overdose of morphia, and was tormented with nausea, retching, and oppression of all his faculties, describes the effect of cold strong coffee as a speedy relief of all these symptoms, and the induction of a state of delightful reverie, which was followed by sound sleep.² Even in desperate cases this remedy has proved effectual. One is related in which more than ten grains of acetate of morphia were taken, and although three hours elapsed before the coffee was administered, and the patient was then comatose, yet he recovered.³ Another is recorded in which a drachm of acetate of morphia was swallowed intentionally. No amelioration of the symptoms occurred until large doses of coffee were administered, but from that period the patient began to recover.⁴

Artificial respiration has occasionally been resorted to with success in poisoning by opium, but is undoubtedly inferior to other means. In infants the alternate compression and siliency of the thorax may be used with advantage when the coma is profound. Enemata of turpentine and of assafoetida ought not to be neglected.

Among the external remedies for narcotism none is more efficient than *cold affusion*. Water at a low temperature should be dashed violently over the head and chest at intervals, and advantage taken of the momentary awakening thus produced, to attack the sensibility in a variety of ways. This partial restoration to consciousness is often attended with a renewal of gastric vitality, and emetics which had for some time remained quiescent in the stomach, then begin to excite

¹ *Annuaire*, &c., 1847, p. 303.

² *Am. Journ.*, &c., Jan. 1841.

³ *Am. Journ.*, &c., July, 1847, p. 259.

⁴ *Annuaire*, &c., 1845, p. 6.

vomiting, and in this manner carry on still further the favorable influence of the cold affusion. Whatever vividly excites the attention helps to carry the system safely through the danger of narcotism, as we learn from instances in which strong mental emotion has actually suspended for a considerable time the symptoms of poisoning, and those still more numerous cases where pain artificially excited has averted the fatal lethargy. Flagellation with rods is one of the best methods employed. The patient should be supported between two stout assistants and forced to walk, while his bare back and loins are smartly fustigated by another person; nor should these means be laid aside until consciousness is completely restored. Ammonia or mustard may be applied to the epigastrium and extremities, and the former occasionally held to the nose. At intervals the patient may lie down and have his skin briskly rubbed with the hand; but for the most part he should be kept in motion, however earnestly he may beg to be let alone.

But it may happen that little or no impression is made upon the symptoms by emetics, cleansing the stomach, coffee, or external irritants, that the respiration is becoming rarer, the pulse weaker, and the stupor more profound. Even in such desperate circumstances a remedy remains which has been repeatedly used with success; this is electricity. It has generally been applied by means of an electro-magnetic apparatus, with which shocks are transmitted along the spine and through the chest of the patient. Each shock of the proper strength arouses the sensibility, and induces a deep inspiration which tends both directly and indirectly to overcome the asphyxia. Cases of the most unlooked for recovery under the influence of this agent are recorded by Dr. Williams,¹ Dr. Page,² Dr. Taylor,³ and several others, and show the importance of keeping an electro-magnetic apparatus at least in all public institutions, for in them the greater number of cases of narcotic poisoning are treated. The reaction which follows poisoning by opium or its preparations sometimes requires blood-letting, like other cases of vascular excitement; but, during the symptoms of asphyxia, depletion is of very questionable utility, if, indeed, it is not positively mischievous. It has, however, been practised upon the ground that the soporose symptoms arise from cerebral congestion. This theoretical view is not sustained by the results of experience. If blood be drawn at all, it should be by the application of cups to the

¹ London Lancet, July 31, 1841.

² Am. Journ. of Med. Sci., April, 1843, p. 301.

³ On Poisons in relation to Med. Juris., 2d Am. ed., p. 535.

temples and back of the neck; but this measure ought to be regarded as quite subsidiary to those which have been before advised.

It may not be without profit to mention that the most successful means which have been employed to cure the habit of opium eating, consist in the gradual diminution of the dose of opium without the patient's privacy, and the equally gradual substitution for it of aromatic and stimulant tonics. Ginger, black pepper, colombo, and quassia, may be employed successively for this purpose.¹

¹ Mr. LITTLE, Month. Journ. of Med. Sci., June, 1850, p. 530.



